

# ***HOISTING ENGINES AND APPLIANCES.***



*Sixth  
Edition*

*Catalogue No. 2*

*Code Word:  
ASPERION*

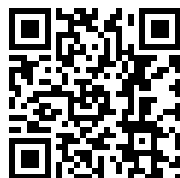
***ALLIS-CHALMERS CO.  
FRASER & CHALMERS WORKS  
CHICAGO, ILL.***

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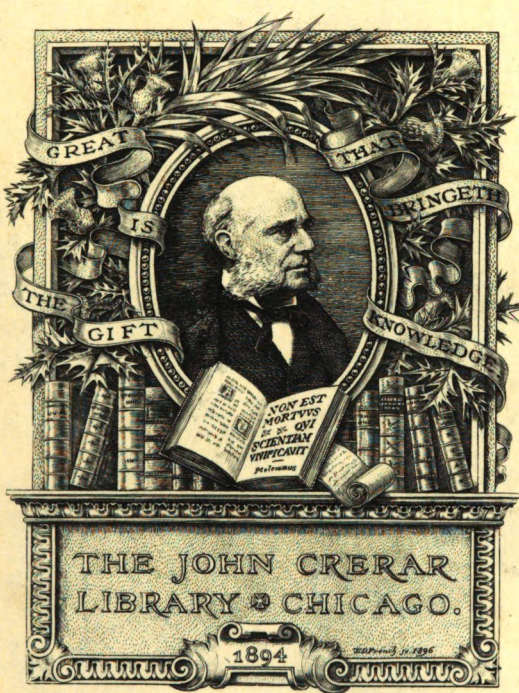
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# Hoisting and Haulage Engines and Appliances

## CATALOGUE No. 2

DECEMBER 1901.

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CHICAGO, ILL.

SIXTH EDITION

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## ALLIS-CHALMERS COMPANY,

FRASER & CHALMERS WORKS.

MANUFACTURERS OF  
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lurgical Machinery  
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Etc. . . . .

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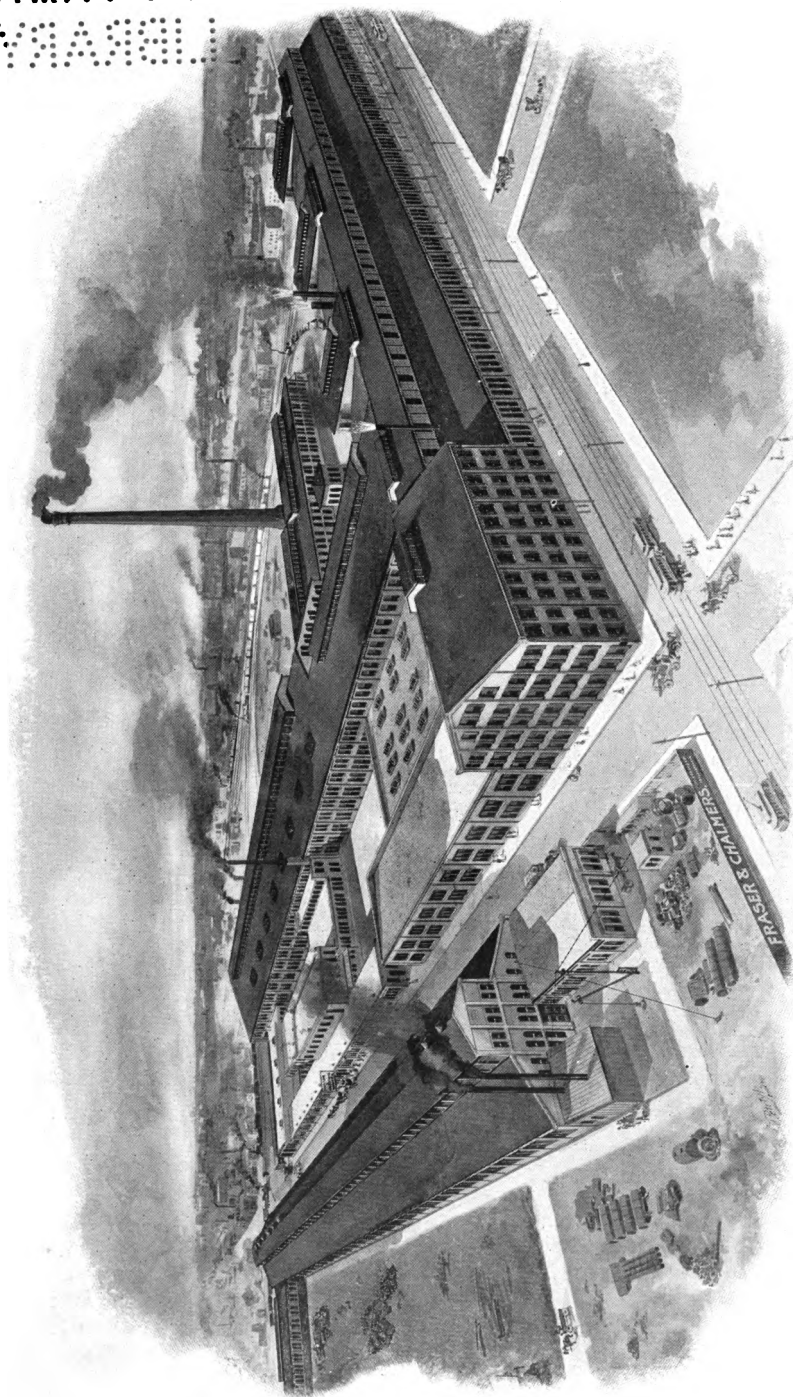
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ALLIS-CHALMERS CO.—FRASER & CHALMERS WORKS, CHICAGO, ILL.

## PREFACE

**T**HIS CATALOGUE will present, briefly, information regarding hoisting in general, and the various types and forms of hoisting engines made by us in accordance with specifications of our patrons, or in accordance with designs of our own. Having for many years been manufacturers of Mining Machinery, we naturally have learned by experience all requirements of machines used in the mining industry.

We have installed hoisting machinery in nearly all parts of the world, and by keeping ourselves thoroughly informed of the methods used and results obtained at the most progressive mines, we are enabled to design and construct plants best adapted to the requirements and conditions of any particular installation.

In the following pages are shown selected illustrations of hoisting engines, covering a wide range of requirements. A brief description is given of each type, which, in conjunction with the cut, will enable the practical miner to at once appreciate the various points of merit.

We call special attention to the fact that

EVERY HOISTING ENGINE BUILT  
BY US IS ERECTED COMPLETE IN  
OUR SHOPS BEFORE SHIPMENT.

This increases the first cost of such machinery, but is eventually the cheapest course, as it insures the purchaser against costly delays in erection at the mine.

**Allis-Chalmers Company.**

## BUSINESS CORRESPONDENCE

Delays may be avoided, if, in writing for information or prices regarding machinery, attention is given to applicable questions in the following list.

Please answer these fully in writing for estimates, that we may have a clear understanding of the conditions under which the hoist will operate.

### Regarding Shaft:

Is the shaft vertical or inclined?

If inclined, give angle from the horizontal.

If the shaft has more than one incline, give the angles of inclinations and length of each incline in the shaft.

How deep is the shaft?

(If the shaft is inclined, give length of incline and not vertical depth.)

Has the shaft single or double compartment?

Send a small sketch showing dimensions of shaft compartments and guide timbers.

How far from the shaft will the hoist be placed?

### Load:—(See Article page 108.)

How many cubic feet per ton does the rock average?

If you have cars or skips, give weight of same and capacity.

If you have cages, give weight, and state whether single or double deck.

How much ore per hour do you wish to hoist?

What proportion of the time will hoist be required to hoist men and timbers?

Will it ever be necessary to hoist load unbalanced?



## **Regarding Boilers:**

What steam pressure will be carried?

How far from the boilers will the hoist be located?

Do you burn coal, wood or oil for fuel?

## **In General:**

Is there any particular system of hoisting that you prefer?

Do you desire engines simple or compound, condensing or non-condensing?

Do you wish cars, cages, buckets or self-dumping skips?

Do you prefer flat or round rope?

Will you please state facilities for transportation, as such information may have great bearing upon the design of the desired machinery.

One point which we particularly desire to have prospective purchasers consider is the following:

Unless otherwise stated, the capacities of hoists given by us in this catalogue, and when quoting on special designs, indicate the maximum loads under which the engines will start with the cranks in any position.

## **Telegraphic Codes:**

All Standard Codes also Fraser & Chalmers (2 Volumes)  
Codes used by the Allis-Chalmers Co.

**Address all communications to the Company.**

PLATE 741.



## FRICTION BAND CLUTCH

The clutch shown by Plate 741 is our standard band friction clutch and is a most simple, durable and effective device for driving hoisting drums. The collar, when moved towards the drum, operates a toggle. The motion is transmitted through a steel lever and a powerful pull is given the friction band tightening it around the clutch ring.

The band is lined with wooden segments which can be easily replaced when worn out.

# **HOISTS USING ROUND ROPE**

**Single Drum  
Double Drum  
Conical Drum  
Geared and  
Direct Acting**



## PORTABLE HOISTS

Our Portable Hoists are built with single or double drums (see pages 11 and 25). They are unsurpassed in compactness, durability and simplicity of construction. The engines of double cylinder hoists are connected by a cast iron bed plate to which they are firmly bolted, making a solid and rigid base requiring no special foundation.

All unnecessary finish has been done away with and we have put its cost into substantial workmanship and material.

The drums fitted with our band friction clutch shown on page 8 are loose on their shafts, drum hubs are lined with removable brass bushings, clutch and brake being of sufficient strength to easily hold maximum load. Shafts, rods and pins are of high grade steel and not, as is so frequently the case, made of inferior material.

All operating levers are conveniently arranged. Cylinders are neatly lagged with sheet iron. All parts are accessible and provided with ample means for lubrication.

**SINGLE  
DRUM  
HOISTING  
ENGINES**

## **STANDARD SINGLE DRUM PORTABLE HOISTING ENGINE**

Plate 577, on page 13, shows our standard single drum portable hoist.

The hoist is built in three types as follows:

### **With Band Friction Clutch and Band Brake**

This hoist has no reversing gear, and consequently has only two hand levers, as shown by Plate 577. The friction clutch permits of the load being lowered under brake control.

A general description of Portable Hoists will be found by referring to page 10, while on page 15 will be found a table of sizes in which this type of hoist is built.

### **With Band Friction Clutch, Band Brake and Link Motion Reversing Gear**

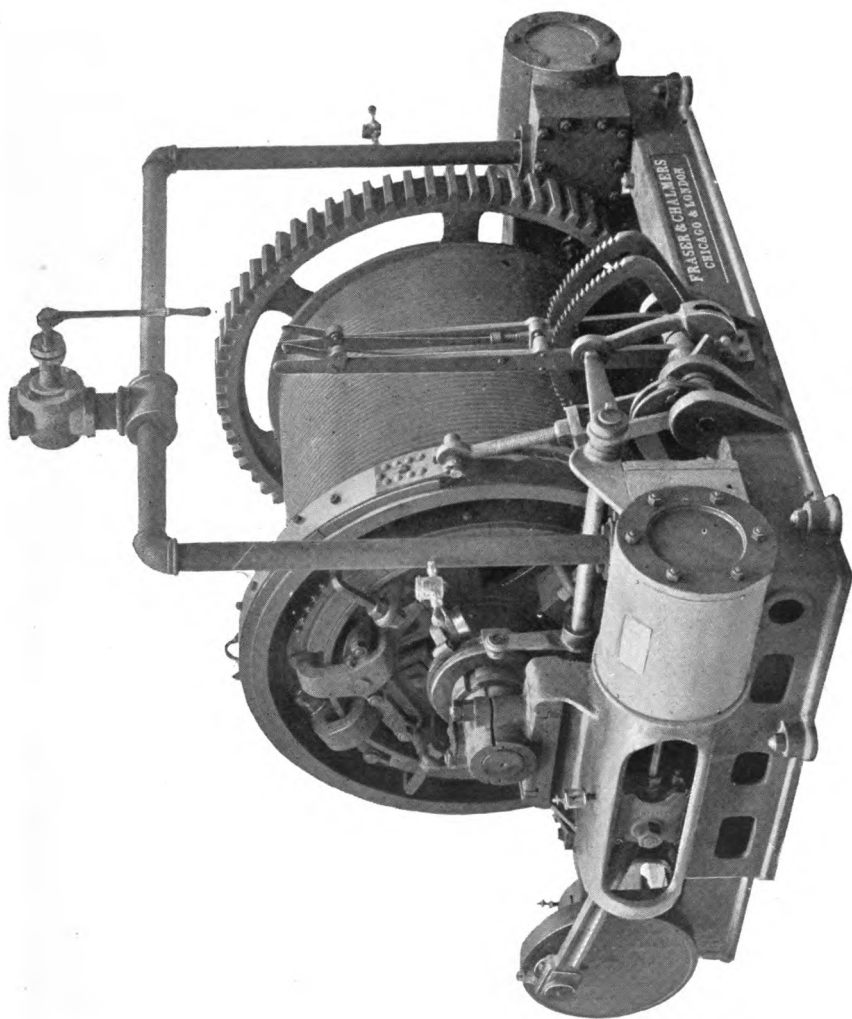
This hoist is similar in all respects to the one previously described, except that it is, in addition, provided with a reversing gear. This hoisting engine is shown by cut on front cover. With this hoist, the load may be lowered under steam as well as under brake control, the advantage of the former method being increased safety when lowering men.

On page 16 will be found a table of sizes in which this type of hoist is built.



ALLIS-CHALMERS CO., CHICAGO.

PLATE 577.



Single Drum Portable Hoisting Engine.

The third type of hoist is

### **With Drum Keyed to Shaft, Band Brake and Link Motion Reversing Gear.**

In this hoist the drum is keyed to the shaft, placing it under direct control of the steam. The construction is simpler than that of the two preceding types and the weight is less, this resulting in a hoist of less cost.

On page 17 will be found a table of sizes in which this type of hoist is built.

These hoists may be made sectional (300-lb. limit) to facilitate transportation in mountainous regions; weight of heaviest piece 350 lbs.

THE EXPENDITURE FOR REPAIRS ON A POORLY DESIGNED HOIST MAY AMOUNT TO MORE IN A SINGLE SEASON THAN THE ORIGINAL OUTLAY FOR THE INSTALLATION. MACHINE SHOPS AND MINES ARE NOT USUALLY LOCATED IN PROXIMITY TO EACH OTHER AND DELAYS ARE COSTLY. OUR REPUTATION AS BUILDERS OF HOISTING MACHINERY IS THE RESULT OF MANY YEARS OF EXPERIENCE AND PROSPECTIVE PURCHASERS CAN PROVIDE NO BETTER SAFEGUARD AGAINST THE CONTINGENCIES MENTIONED THAN THAT OUR NAME-PLATE REPRESENTS WHEN ON A MACHINE.

# FRASER & CHALMERS' STANDARD DOUBLE CYLINDER SINGLE DRUM PORTABLE HOISTING ENGINE

With Band Friction Clutch and Band Brake.

Standard Drums are Grooved for Size of Rope Specified below.

Steam 80 Lbs. Pressure per Sq. Inch.

Code Word.	No.	Cylinder.		Size Drum.		Dia. Rope.	Feet Rope in One Coil.	R. P. M. of Engine.	Ratio of Gears.	Hoist Speed. Ft. Per Min.	Max. Gross Load.	Diameter Steam Pipe.	Diameter Exhaust Pipe.	Finished Weight.
		Dia.	Stroke.	Dia.	Leng.									
		IN.		IN.		IN.					LBS.	IN.	IN.	LBS.
Agnize.....	0	6	8	24	18	5/8	164	260	4. to 1	400	2,000	1 1/2	2	3,800
Agnocasto.....	1	7	10	32	24	3/4	247	250	5.53 to 1	376	2,800	2	2 1/2	6,900
Agnomen.....	2	8	10	32	36	3/4	375	240	5.53 to 1	360	3,650	2 1/2	3	7,500
Agnominate.....	3	9	12	42	40	3/4	540	235	5.53 to 1	462	4,250	2 1/2	3	11,000
Agnoscebas.....	4	10	12	42	48	3/4	650	225	5.53 to 1	440	5,250	2 1/2	3	12,000
Agnosceus.....	5	10	15	48	40	7/8	500	218	6. to 1	450	6,350	3	3 1/2	18,000
Agnostic.....	6	12	15	48	48	7/8	600	190	5.06 to 1	471	7,200	3	3 1/2	19,500
Agobiaba.....	7	12	18	54	48	7/8	670	180	5.06 to 1	500	8,250	3 1/2	4 1/2	28,000
Agobiamos.....	8	14	18	60	48	1	670	150	5.06 to 1	471	9,900	3 1/2	4 1/2	30,200

# FRASER & CHALMERS' STANDARD DOUBLE CYLINDER SINGLE DRUM PORTABLE HOISTING ENGINE

With Band Friction Clutch, Band Brake and  
Link Motion Reversing Gear.

Steam 80 Lbs. Pressure per Sq. Inch.

Standard Drums are Grooved for Size of Rope Specified below.

Code Word.	No.	Cylinder.		Size Drum.		Dia. Rope.	Feet Rope in One Coil.	R. P. M. of Engine.	Ratio of Gears.	Hoist Speed. Ft. Per Min.	Max. Gross Load.	Diameter Steam Pipe.	Diameter Exhaust Pipe.	Finished Weight.
		Dia.	Stroke.	Dia.	Leng.							IN.	IN.	
Agnellinum.....	0A	6	8	24	18	5/8	164	260	4. to 1	400	2,000	1½	2	4,000
Agnellorum.....	1A	7	10	32	24	¾	247	250	5.53 to 1	376	2,800	2	2½	7,200
Agnellos.....	2A	8	10	32	36	¾	375	240	5.53 to 1	360	3,650	2½	3	7,900
Agnellotto.....	3A	9	12	42	40	¾	540	235	5.53 to 1	462	4,250	2½	3	11,500
Agnelons.....	4A	10	12	42	48	¾	650	225	5.53 to 1	440	5,250	2½	3	12,500
Agnels.....	5A	10	15	48	40	7/8	500	218	6. to 1	450	6,350	3	3½	17,900
Agnette.....	6A	12	15	48	48	7/8	600	190	5.06 to 1	471	7,200	3	3½	19,600
Agnicao.....	7A	12	18	54	48	7/8	670	180	5.06 to 1	500	8,250	3½	4½	28,800
Agnicelli.....	8A	14	18	60	48	1	670	150	5.06 to 1	471	9,900	3½	4½	31,000

# FRASER & CHALMERS' STANDARD DOUBLE CYLINDER SINGLE DRUM PORTABLE HOISTING ENGINE

With Drum Keyed to Shaft, Band Brake, and  
Link Motion Reversing Gear

Steam 80 Lbs. Pressure per Sq. Inch.

Standard Drums are Grooved for Size of Rope Specified below.

Code Word.	No.	Cylinder.		Size Drum.		Dia. Rope.	Feet Rope in One Coil.	R. P. M. of Engine	Ratio of Gears.	Hoist Speed, Ft. Per Min.	Max. Gross Load.	Diameter Steam Pipe.	Diameter Exhaust Pipe.	Finished Weight.
		Dia.	Stroke.	Dia.	Leng.									
		IN.	IN.	IN.	IN.	IN.					LBS.	IN.	IN.	LBS.
Agnilibus.....	0B	6	8	24	18	5/8	164	260	4. to 1	400	2,000	1 1/2	2	3,700
Agnilis.....	1B	7	10	32	24	3/4	247	250	5.53 to 1	376	2,800	2	2 1/2	6,800
Agninos.....	2B	8	10	32	36	3/4	375	240	5.53 to 1	360	3,650	2 1/2	3	7,400
Aginum.....	3B	9	12	42	40	3/4	540	235	5.53 to 1	462	4,250	2 1/2	3	10,800
Agnistich.....	4B	10	12	42	48	3/4	650	225	5.53 to 1	440	5,250	2 1/2	3	11,800
Agnistico.....	5B	10	15	48	40	7/8	500	218	6. to 1	450	6,350	3	3 1/2	17,700
Agnitoare.....	6B	12	15	48	48	7/8	600	190	5.06 to 1	471	7,200	3	3 1/2	19,200
Agnitoris.....	7B	12	18	54	48	7/8	670	180	5.06 to 1	500	8,250	3 1/2	4 1/2	27,600
Agniturae.....	8B	14	18	60	48	1	670	150	5.06 to 1	471	9,900	3 1/2	4 1/2	29,800

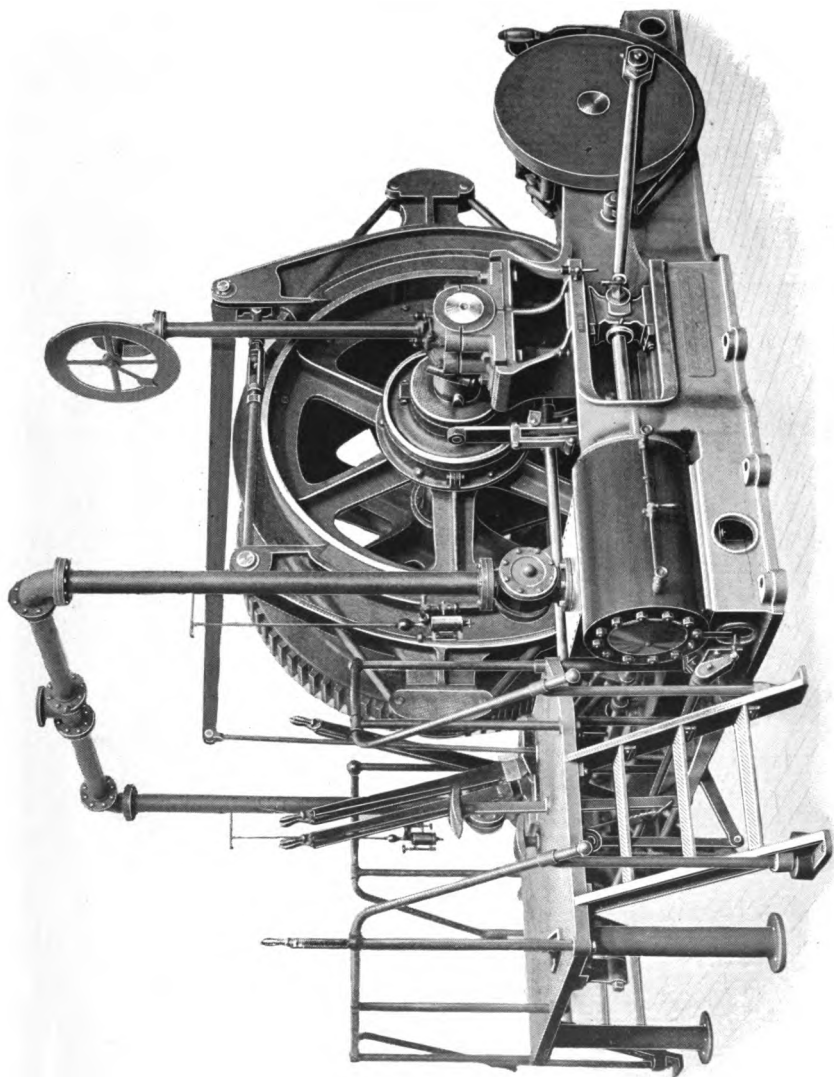
## SINGLE DRUM GEARED HOISTING ENGINE

Plate 746 on page 19 illustrates a compact design of geared hoisting engine intended to be used more especially for continuous and heavy hoisting in the regular operation of a mine but not as a sinking or prospecting hoist. The hoist shown has duplex plain slide valve engines, cylinders 14 in. diameter x 24 in. stroke, and one drum 7 ft. in diameter grooved for round rope. Drum is loose on shaft and fitted with bronze bushings and is driven from shaft by means of a jaw clutch. In order to facilitate clutching in, the disc cranks on engine are fitted with a band brake operated by means of a foot step on the engineer's platform so as to render it unnecessary to handle the heavy post brakes every time the clutch is shifted. The main brake is of the post pattern with large wearing surface on the brake wheel so as to reduce to a minimum the trouble from heating and wear of wooden brake shoes. All of the operations of this hoist are controlled by means of hand levers and foot-steps on the engineer's platform, the levers and foot-steps being so arranged that engineer can easily handle the hoist without moving from his place. Each steam cylinder is fitted with a separate rotary throttle valve close to the cylinder; engines so fitted respond more quickly than those where a single valve is used. The drum is fitted with a dial indicator, positively driven from same, so as to show the position of cage in shaft. The photograph of this hoist was taken from an engine built by Fraser & Chalmers Works for the Congress Gold Company of Arizona. The gross capacity is 9,500 lbs. hoisted at a speed of 650 ft. per minute.



ALLIS-CHALMERS CO., CHICAGO.

PLATE 746.



Single Drum Geared Hoisting Engine.—For Heavy Duty.

## SINGLE DRUM, DOULBE ROPE HOIST

Plate 1058 on opposite page illustrates a Single Drum Hoisting Engine, built by Fraser & Chalmers Works for the Mohawk Mining Co. The cylinders are 14 in. x 18 in. and a link motion reversing gear permits hoisting with two ropes, one leading from the upper and the other from the lower side of the drum. The drum is keyed to the shaft and is 84 inches in diameter and 104 inches face. It was made this length to allow winding the two ropes on it, one from each end and in opposite directions. With this arrangement hoisting can be done from two shafts with the cages in balance and hoisting from the same level.

The capacity of the hoist is 15000 lbs., gross load, hoisted at the rate of 1000 feet per minute from a depth of 1500 feet, the shaft being at an incline of 41 degrees. One end of drum may be provided with a suitable take-up to adjust length of rope in use and thus readily permitting changing to other levels from which material may be hoisted.

We have built six of these engines and they continue to be very popular.

FOR BALANCED HOISTING ON A LARGE SCALE,  
SEE WHITING TYPE OF HOISTING ENGINE HEREIN  
DESCRIBED.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 1058.



Single Drum Geared Hoisting Engine.—For High Speed.

## DIRECT ACTING SINGLE DRUM HOISTING ENGINE

Plate 747 on page 23 shows the Direct Acting, Single Drum Hoisting Engine, built by Fraser & Chalmers Works for the Peñoles Mine.

This hoist is driven by Duplex  $12\frac{1}{4}$  in. x 24 in. Corliss Engines and is fitted with a standard band friction clutch, band brake and link motion reversing gear.

All operations of hoist are controlled by hand levers which are conveniently grouped on engineer's platform.

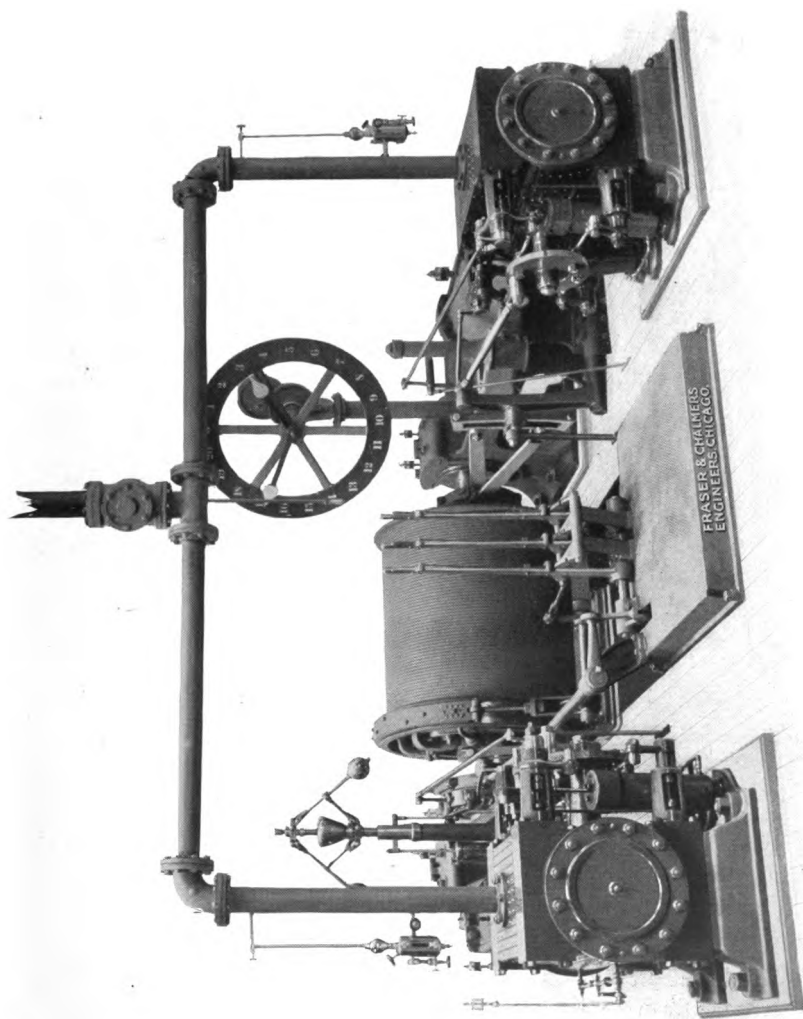
The dial indicator, it will be noticed, has two hands, one hand making a complete revolution in the entire length of the lift, while the other one makes a complete revolution in the last 100 feet of the lift, thus indicating more positively the position of the skip or cage, and enabling the engineer to prevent over-winding.

The capacity of the engine is 3500 pounds, hoisted at a speed of 1000 feet per minute from a depth of 1800 feet.

OUR VARIOUS DESIGNS ALL HAVE UNUSUALLY  
LIBERAL BRAKE AND CLUTCH FRICTION SUR-  
FACES THUS REDUCING THE PRESSURE PER  
SQUARE INCH AND SECURING GREATER DURA-  
BILITY AND SAFETY.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 747.



Direct Acting Single Drum Hoisting Engine.

## INCIDENTALLY

Single Drum Hoisting Engines may be designed so as to permit an additional drum to be fitted on the shaft at some future time.

This arrangement involves but comparatively little extra expense and permits the capacity of the hoist to be augmented to keep pace (within certain limits) with the development of the mine, thus saving to the mine owners the possible expense of purchasing a second hoist of greater capacity.

A hoisting engine of the character above referred to was built some years ago by Fraser & Chalmers Works for the Elkhorn Mining Company. This hoist was of the double cylinder, single drum, direct acting type. Size of cylinders 20 in. x 60 in., size of drum 9 ft. x 3 ft. 6 in. The post brake, jaw clutch and link motion reversing gear are steam operated; it is also fitted with crank brakes, indicator, etc. This hoisting engine was in operation many years as a single drum hoist, but has lately been fitted with the second drum and necessary operating mechanism for same; in this manner more than doubling capacity of hoist at a small outlay.

We build hoisting engines to be operated either by steam, compressed air, electricity, water power, etc., also so designed that where several of the forces mentioned are available for use either may be employed in turn at the will of the operator.

A hoist of the latter mentioned type was recently built by Fraser & Chalmers Works for the Tomboy Gold Mines Company, Limited, and is to be driven by compressed air or electricity.

A hoist built by Fraser & Chalmers Works for the Darien Gold Mining Company can be driven by steam or by water.

Our extended and varied experience in designing and building standard and special hoisting engines places us in a position to assure the customer that the power available will be utilized in the most economical and efficient manner.

We value correspondence relating to the subject and shall be pleased to give customers our best advice and judgment.

**DOUBLE  
DRUM  
HOISTING  
ENGINES**

**FRASER & CHALMERS'**  
**STANDARD**  
**DOUBLE CYLINDER, DOUBLE DRUM,**  
**PORTABLE HOISTING ENGINE,**  
**WITH**  
**Band Friction Clutches, Band Brakes and Link**  
**Motion Reversing Gear**

Plates 1062 and 1063 represent our Double Cylinder, Double Drum Hoisting Engine, with Band Friction Clutches, Band Brakes and Link Motion Reversing Gear. This Hoist is designed for double compartment shaft.

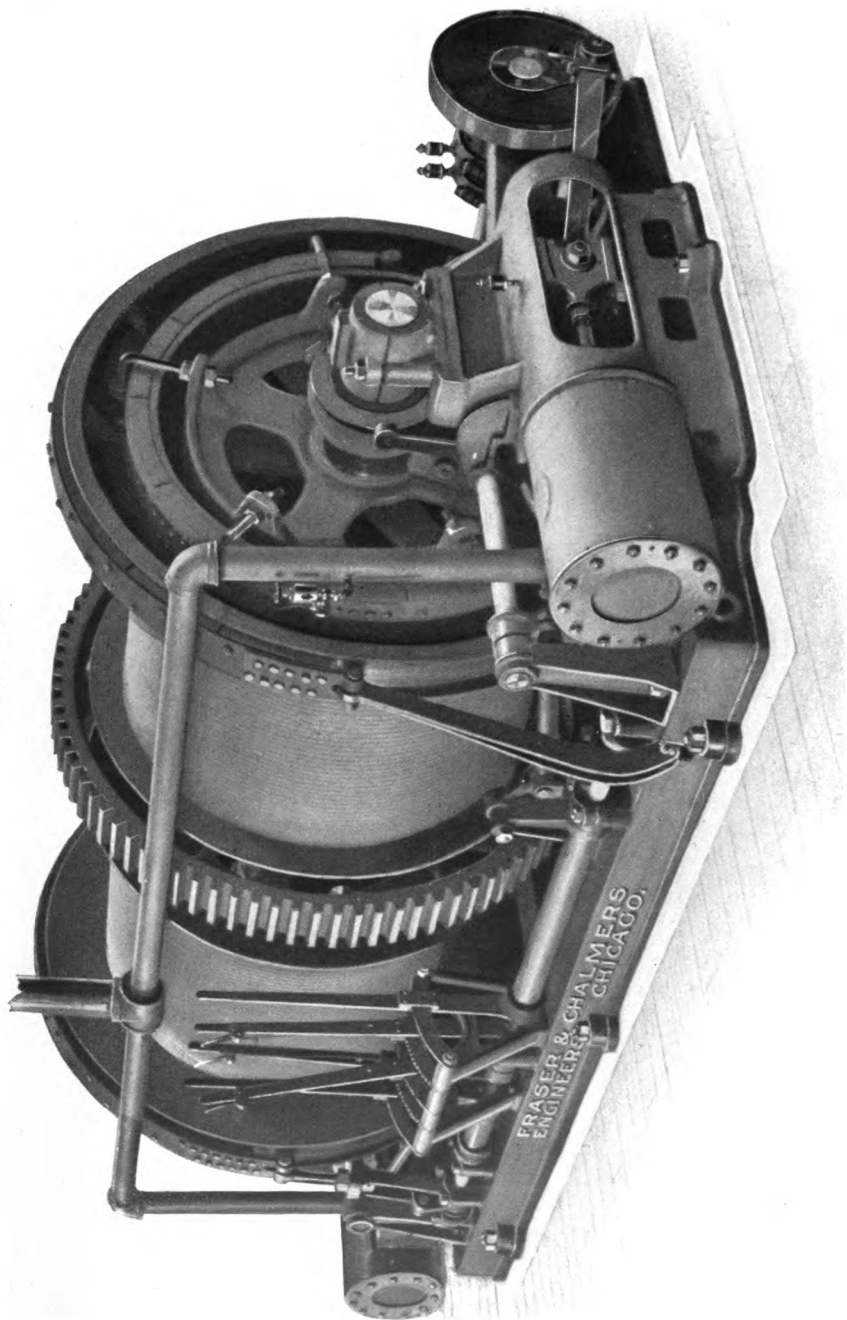
Both drums are loose on shaft and each is provided with an independent band friction clutch for driving same, permitting the hoisting to be performed balanced or unbalanced as required. Where hoist will always run in balance, and from the same level, the clutches may be omitted, and drums keyed to shaft.

The hoisting engine represented by the illustrations was built by Fraser & Chalmers Works for the American Mining Company. Its cylinders are 14 in. x 18 in. and it has a capacity of 200 tons per 24 hours from a depth of 1600 feet. The drums are independent and the engine is reversible.

The American Mining Company after two years' operation of this hoist ordered a duplicate which speaks well for the satisfactory working of the first engine.



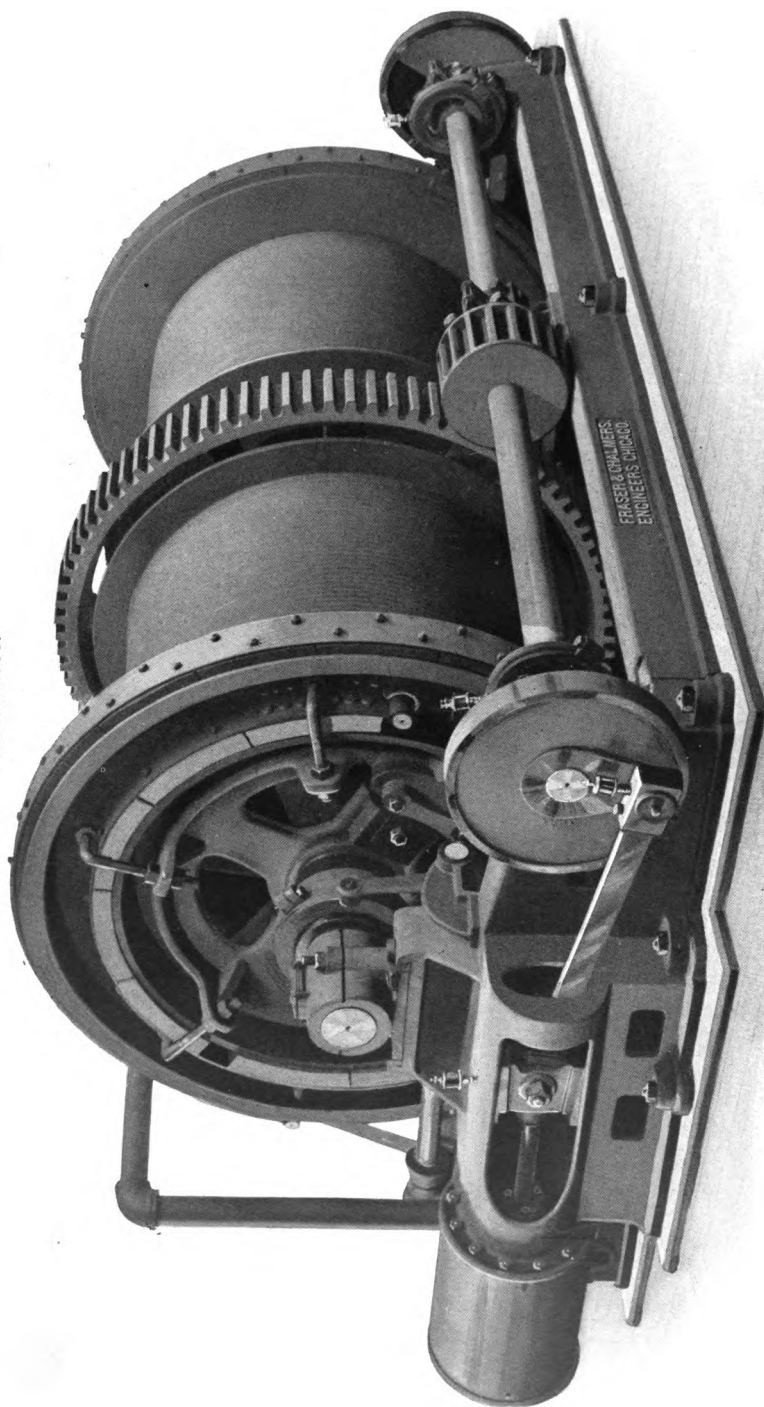
PLATE 1062.



Double Drum Geared Portable Hoisting Engine.—Cylinder End.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 1063.



Double Drum Geared Portable Hoisting Engine.—Crank End.

# FRASER & CHALMERS' STANDARD DOUBLE CYLINDER DOUBLE DRUM PORTABLE HOISTING ENGINE

With Friction Band Clutches, Band Brakes, and  
Link Motion Reversing Gear

Standard Drums are Grooved for Size of Rope Specified below.      Steam 80 Lbs. Pressure per Sq. Inch.      Cut-off at  $\frac{3}{4}$  Stroke.

Code Word.	No.	Cylinders.		Drums.		Dia. of Rope.	Feet Rope in One Coil.	R. P. M. of Engine.	Ratio of Gears.	Hoist Speed. Ft. Per Min.	Max. Gross Load.	Diameter		Finished Weight.
		Dia.	Stroke.	Dia.	Leng.							Steam Pipe.	Exhaust Pipe.	
		IN.	IN.	IN.	IN.	IN.					LBS.	IN.	IN.	LBS.
Agutinaba.....	50	9	12	42	24	$\frac{3}{4}$	330	235	5.53 to 1	462	4,250	2 $\frac{1}{2}$	3	18,200
Agutinado.....	51	10	12	42	36	$\frac{3}{4}$	485	225	5.53 to 1	440	5,250	2 $\frac{1}{2}$	3	21,300
Agutinails.....	52	10	15	48	40	$\frac{7}{8}$	500	218	6. to 1	450	6,350	3	3 $\frac{1}{2}$	29,500
Agutinare.....	53	12	15	48	48	$\frac{7}{8}$	600	190	5.06 to 1	471	7,200	3	3 $\frac{1}{2}$	32,500
Agutino.....	54	12	18	54	48	$\frac{7}{8}$	670	180	5.06 to 1	500	8,250	3 $\frac{1}{2}$	4 $\frac{1}{2}$	45,000
Agminal.....	55	14	18	60	48	1	670	150	5.06 to 1	471	9,900	3 $\frac{1}{2}$	4 $\frac{1}{2}$	47,000

Plate 1050, on page 31, shows a Double Drum Hoisting Engine sectionalized to 300 pounds limit, for mule-back transportation. This hoist is driven by a duplex slide valve engine, cylinders 8 in. diameter by 12 in. stroke, and is fitted with drums 42 in. diameter by 36 in. face. Drums are driven from shaft by means of our standard band friction clutches and each drum is fitted with a band brake. The engine has link motion reversing gear and column indicators show the position of the cage in the shaft. This hoisting engine has a capacity of 3,600 lbs. gross load hoisted at a speed of 460 ft. per minute from a depth of 600 ft. Compressed air or water power can be used to operate the hoist.

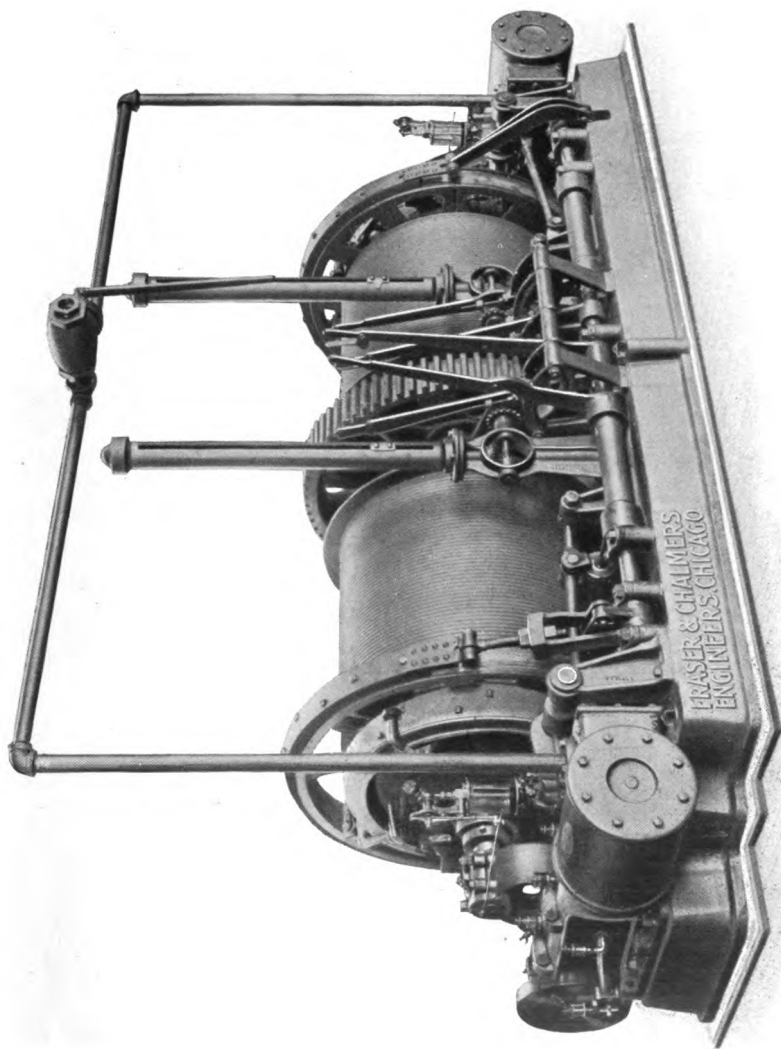
\* The cut shows how neatly the sectionalizing has been accomplished, as notwithstanding the fact that the bed plate is made in many pieces the joints are practically invisible.

The hoist was built by Fraser & Chalmers Works for the Darien Gold Mining Company.

WE MAKE A SPECIALTY OF MACHINERY SECTIONALIZED SO AS TO FACILITATE TRANSPORTATION IN REGIONS DIFFICULT OF ACCESS.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 1050.



Double Drum, Geared Hoisting Engine.---Sectionalized to 300 Lb. Limit.

## SPECIAL DOUBLE DRUM, GEARED HOISTING ENGINES

The Double Drum Geared Hoisting Engines shown on pages 33, 35, and 37 were furnished the Alaska United Gold Mining Company by Fraser & Chalmers Works. They are of special design for heavy and rapid hoisting. The drums are driven by band friction clutches and are fitted with post brakes. The brakes and clutches are applied by hand wheels, the brakes on the crank discs are applied by a foot lever. The link motion reversing gear is operated by a hand lever.

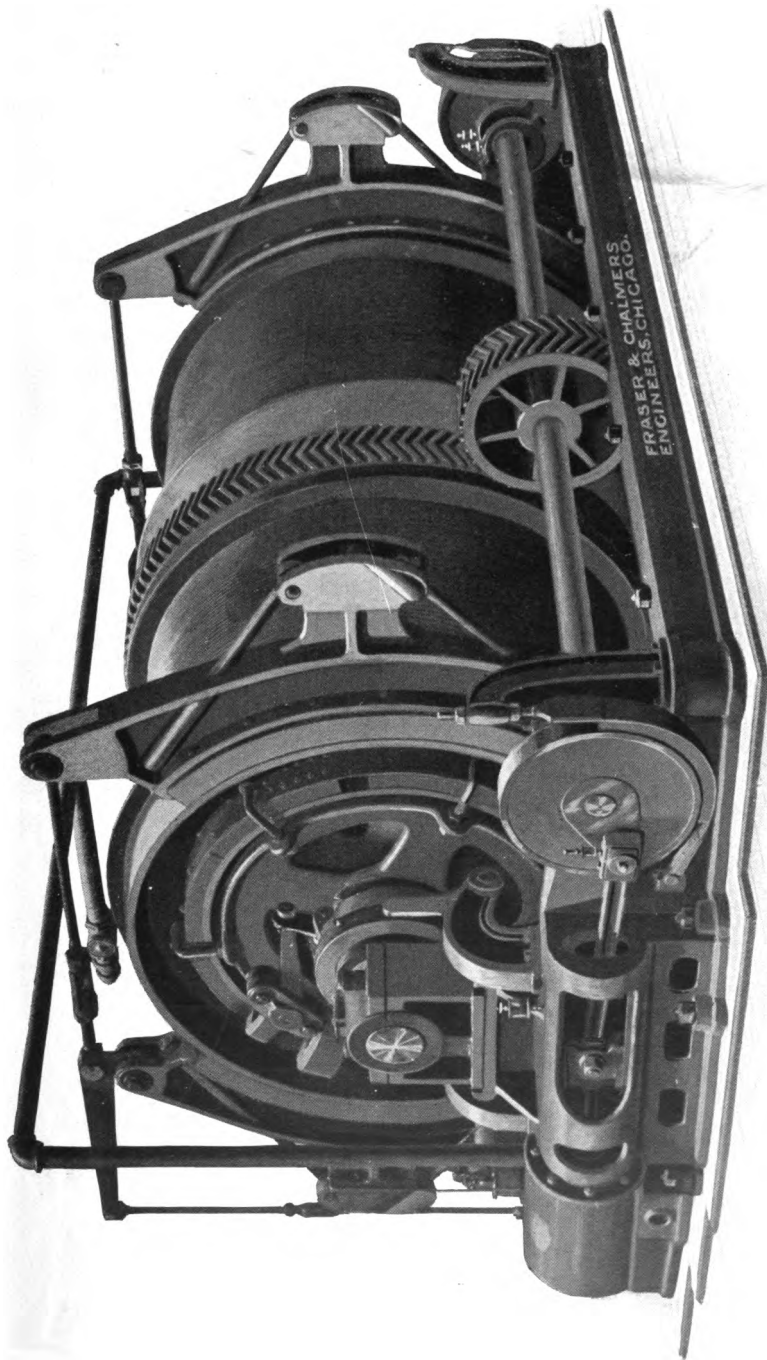
Plate 1052, on page 33, shows the 12 in. x 16 in. Hoisting Engine, and Plate 913, on page 35, shows the 15 in. x 24 in. Hoisting Engine. Plate 1051 is described in detail on page 36.

On page 34 is given a table of sizes, capacities, etc., for these three hoisting engines. If the standard sizes do not meet the requirements, we will be pleased, upon application, to quote upon special hoisting engines.

SINCE THE ABOVE NAMED HOISTS WERE DELIVERED WE HAVE RECEIVED AN ADDITIONAL ORDER FROM THE SAME COMPANY FOR A DUPLICATE HOISTING ENGINE. CONCERNING THE EFFICIENCY OF OUR HOISTS, THE MANAGER OF THE MINE WRITES AS FOLLOWS: "THESE FRASER & CHALMERS HOISTING ENGINES ARE THE BEST DESIGNED ENGINES FOR THIS WORK I AM ACQUAINTED WITH."

ALLIS-CHALMERS CO., CHICAGO.

PLATE 1052.



Special Double Drum Geared Hoisting Engine.

FRASER & CHALMERS'  
SPECIAL DOUBLE CYLINDER, DOUBLE DRUM, GEARED  
HOISTING ENGINES

With Band Friction Clutches, Post Brakes and Link  
Motion Reversing Gear

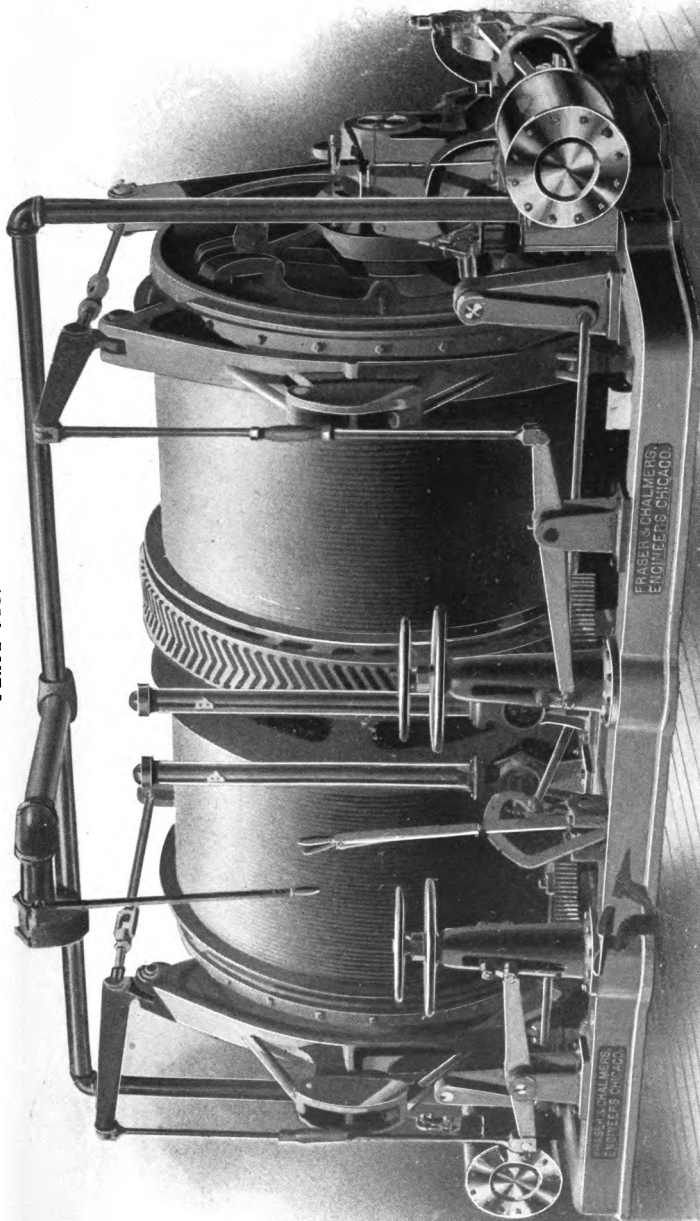
Steam 110 Lbs. Pressure per Sq. Inch.

Code Word.	Cylinders.		Drums.		Feet Rope in One Coil.	R. P. M. of Engine.	Ratio of Gears.	Hoist Speed Ft. Per Min.	Max. Gross Load.	Diameter Steam Pipe.	Diameter Exhaust Pipe.	Finished Weight.
	Dia.	Stroke.	Dia.	Leng.								
	IN.	IN.	IN.	IN.					LBS.	IN.	IN.	LBS.
Agnituros.....	12	16	84	48	1000	150		1000	4,700	3	3½	70,000
Agniturun.....	14	18	84	48	1000	150	3.32 to 1	1000	7,200	3½	4½	71,200
Agnodemus.....	15	24	84	58	1000	150		1000	11,000	4	5	90,000



ALLIS-CHALMERS CO., CHICAGO.

PLATE 913.

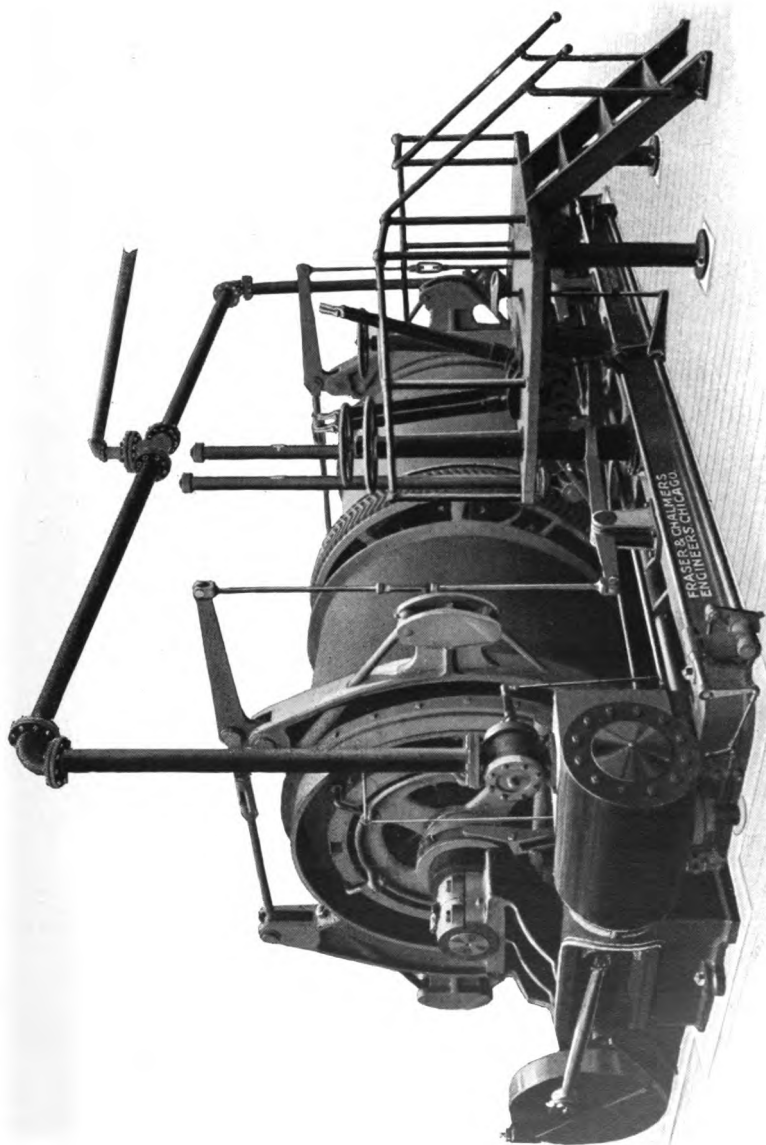


Special, Double Drum, Geared Hoisting Engine.

## DOUBLE DRUM, GEARED HOISTING ENGINE

On the opposite page is shown a Double Drum, Geared Hoisting Engine (Plate 1051), built by Fraser & Chalmers Works for the Alaska United Gold Mining Co. Cylinders are 15 inches in diameter by 24 inches stroke. It is similar to the hoisting engines described on page 32, differing only in being of larger dimensions and being operated from a raised platform instead of from the floor. Like the others, it has post brakes, band friction clutches, column indicators, etc., as well as helical-tooth gears, by means of which increased strength and smooth running qualities are obtained. Details of dimensions, capacities, etc., will be found in the table on page 34.

PLATE 1051.

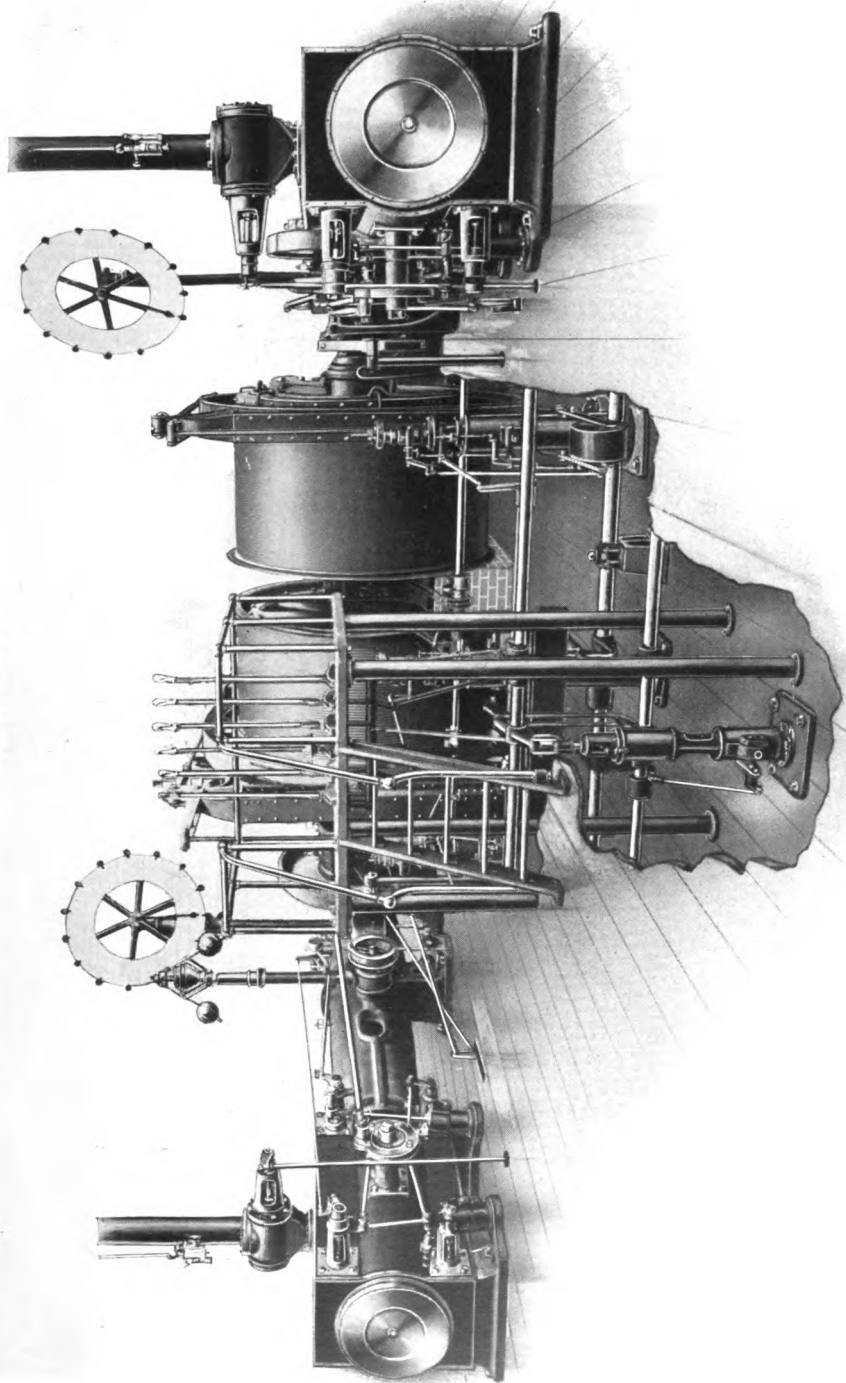


Special Double Cylinder, Double Drum, Geared Hoisting Engine.

## DIRECT ACTING DOUBLE DRUM HOISTING ENGINE

Plate 1267 on the opposite page illustrates a direct acting double drum hoisting engine built by Fraser & Chalmers Works for the Le Roi Mines of the British American Corporation. The cylinders are 24 in diameter x 60 in. stroke, and drive by means of friction clutches two straight faced drums 10 ft. diameter by 5 ft. face. Each drum is provided with a powerful post brake and band friction clutch, the drums being loose on the shaft, and driving from same by means of these clutches. The reversing gear, clutches, brakes and throttles are all operated by means of auxiliary steam cylinders fitted with oil cataract for checking motion of same. The disc cranks were made extra large and fitted with band brakes operated by means of footstep on the engineer's platform. Engine is fitted with automatic safety stop driven by the same mechanism as the indicators, the safety stop being so designed that in case of overwinding, the cut-off is adjusted so that steam cannot enter the steam cylinders, and the reversing and brake engines operated so as to bring hoist to a stop. This hoisting engine is designed to hoist a total unbalanced load of 14250 pounds up a shaft at an incline of 67 degrees from the horizontal.

We are now building a hoisting engine of the same general design as the above described hoist, for the Consolidated Bonanza Gold Mines Company, with steam cylinders 20 in. diameter by 48 in. stroke, driving two drums 6 ft. diameter by 7 ft. face.



Direct Acting Double Drum Hoisting Engine.

## HOISTING ENGINE

### DIRECT ACTING, DOUBLE DRUM

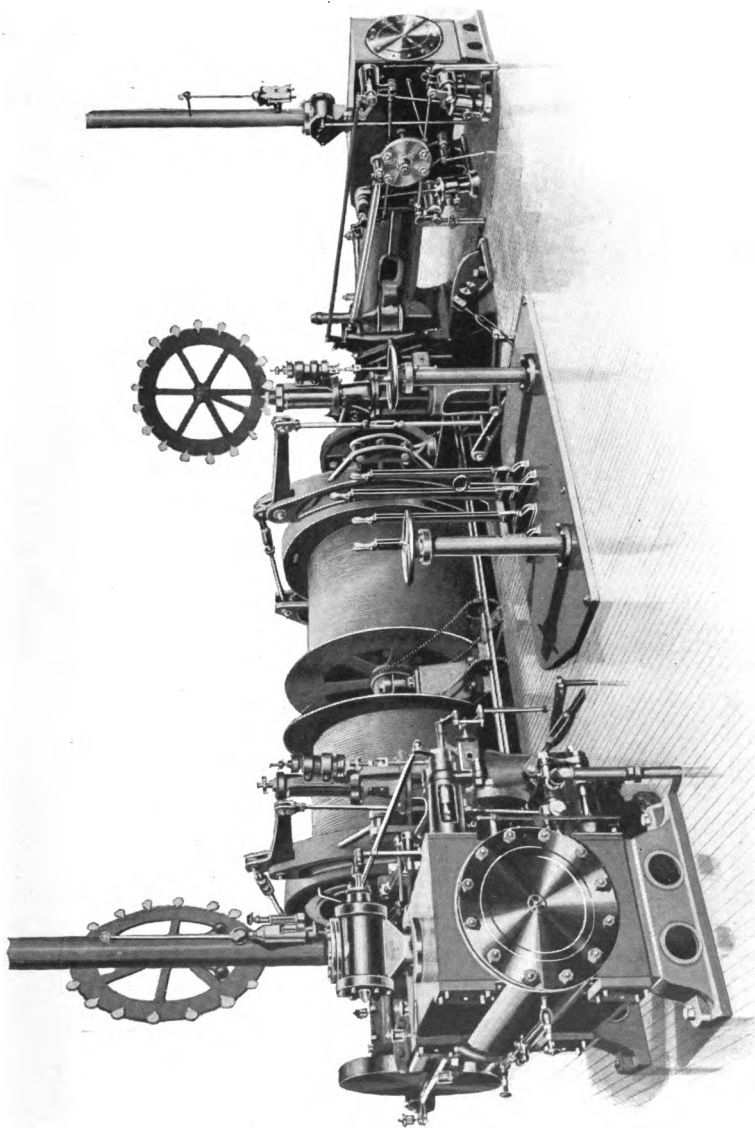
PLATE 1085.

Plate 1085, on opposite page, shows a Direct Acting Double Drum Hoisting Engine built by Fraser & Chalmers Works for the Virtue Consolidated Mines. The cylinders are 16 in. x 36 in., Corliss type. The drums are 60 in. diameter and 48 in. face. The operating levers are grouped together between the cylinders on platform on the floor level. The friction clutches, link reversing gear, throttle and release valves are all operated by hand, while the post brakes are operated by auxiliary steam cylinders, fitted with oil check.

This engine is designed to hoist a total load of 6000 pounds at a speed of 1250 feet per minute, from a depth of 1500 feet.

OUR HIGH GRADE CORLISS HOISTING ENGINES ARE OPERATED UNDER GOVERNOR CONTROL, THEREBY SECURING THE GREATEST ECONOMY IN FUEL CONSUMPTION AND PREVENTING A SPEED THAT WOULD BE DANGEROUS ALIKE TO ENGINE AND LOAD.

PLATE 1085.



Direct Acting Double Drum Hoisting Engine.

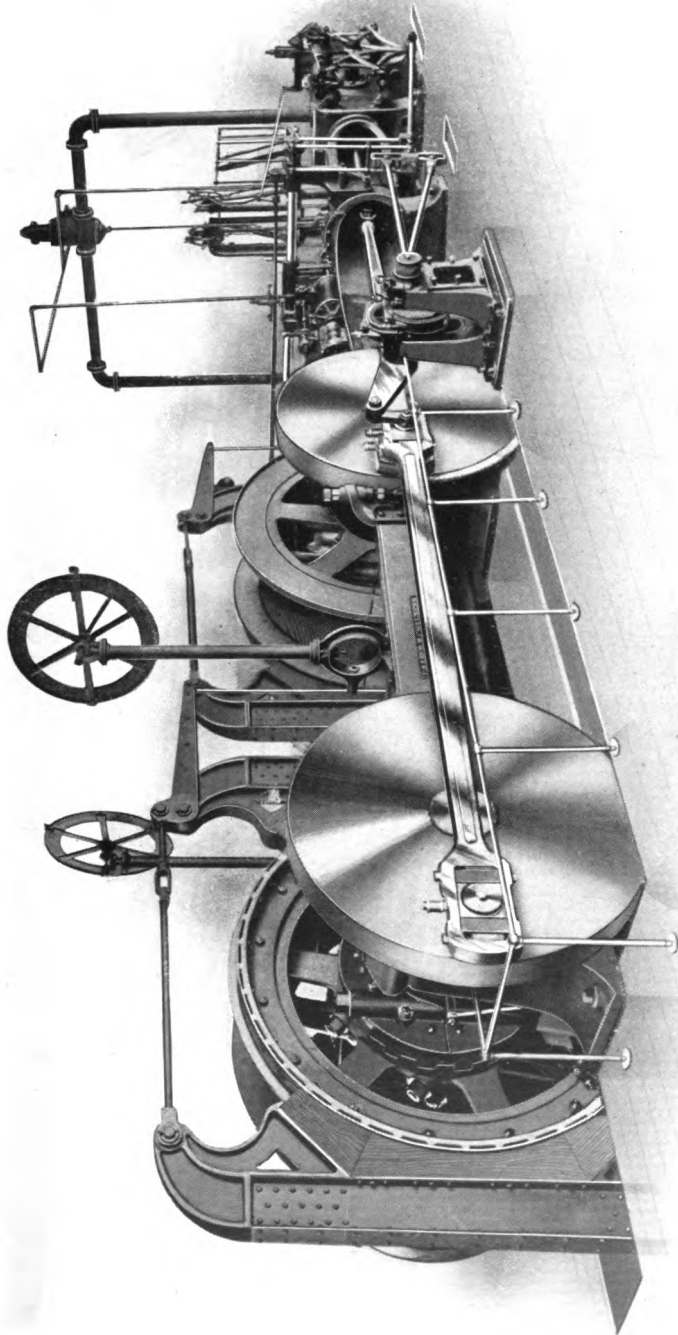
## SPECIAL DIRECT ACTING DOUBLE DRUM HOISTING ENGINE

Plate 1265 and 1266 on pages 43 and 44 illustrate a special direct acting double drum hoisting engine of which Fraser & Chalmers Works have built 3 for the Rand Mines, Ltd., cylinders 17 in. diameter by 60 in. stroke driving two drums 8 ft. diameter by 2 ft. 8 in. face, especially designed to permit of overwinding four coils of rope so that drums will hold 5000 feet of  $1\frac{1}{8}$  in. rope. Each drum is fitted with a powerful post brake and Seymour jaw clutch, both clutches and brakes being operated by hand. The reverse motion is actuated by auxiliary steam cylinder having oil cataract cylinder.

Ultimately, these engines will be converted into duplex tandem compound engines by the addition of a 28 in. and 26 in. low pressure cylinder. The intention is to use these engines for sinking the shafts, and after the shafts are sunk, to add the low pressure cylinder and change the present straight face drums to Whiting drums which will convert the engine into the hoisting engine shown on plates 1095 and 1096 on pages 55 and 56 of this catalogue. The peculiar arrangement of the valve gear is adopted in order to cut down the length between bearings on crank shaft, in order to make the shaft better able to resist the numerous blocking strains which will exist when engine is converted into a Whiting hoist.

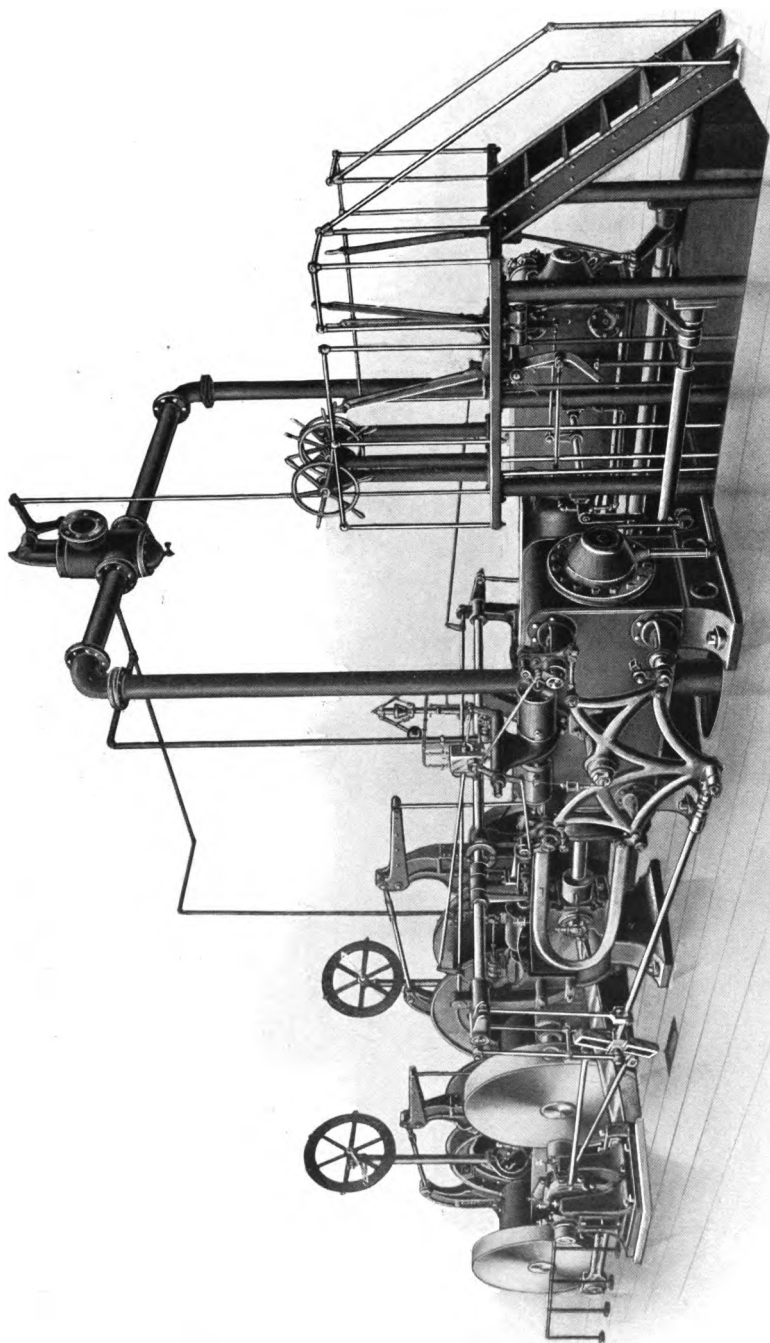


PLATE 1266.



Special Direct Acting Double Drum Hoisting Engine.

PLATE 1265.



Special Direct Acting Double Drum Hoisting Engine.

**CONICAL  
DRUM  
HOISTING  
ENGINES**

## CONICAL DRUM HOISTING ENGINE

A development of the Single Cylindrical Drum with two ropes is the Double Cone Drum. The theory of this construction is that as the weight of the rope increases, the radius at which it acts correspondingly decreases, thus equalizing the work of the engine. The dimensions of drum must be calculated to suit each particular case, and if used under different circumstances, the drum would fail to fulfill the purpose of its design. For very deep hoisting, in order to balance the great weight of rope, the central portion of the drum would become inconveniently large in diameter, therefore this portion is made cylindrical and is used by both ropes. This arrangement also shortens the drum, but of course makes it impossible to perfectly balance weight of rope.

On the opposite page is shown the first of two Conical Drum Hoisting Engines built by Fraser & Chalmers Works for the Atlantic Mining Company. The drum is 10 ft. small diameter and 15 ft. 6 in. large diameter. It is fixed on the shaft and provided with take-ups for adjusting the lengths of ropes. The brakes are steam operated and of the band type. The cylinders are of Corliss type, 26 in. by 48 in., being designed to form the low pressure cylinders of a duplex tandem compound engine, the high pressure cylinders of which will be added later. A cut-off governor adapted to hoisting engine work controls the speed.

The capacity of this hoisting engine, running in balance, is 7000 pounds of ore hoisted at an average speed of 2400 ft. per minute, up an incline of 55 degrees from the horizontal, 2000 feet in length.

One of the largest Conical Drum Hoisting Engines ever built was recently constructed by Fraser & Chalmers Works for the Atlantic Mining Company. The drum is 25 ft. 6 in. in diameter at its center and 12 ft. at ends, and is running perfectly true.

A description and cut of the drum will be found on pages 48 and 49.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 940.

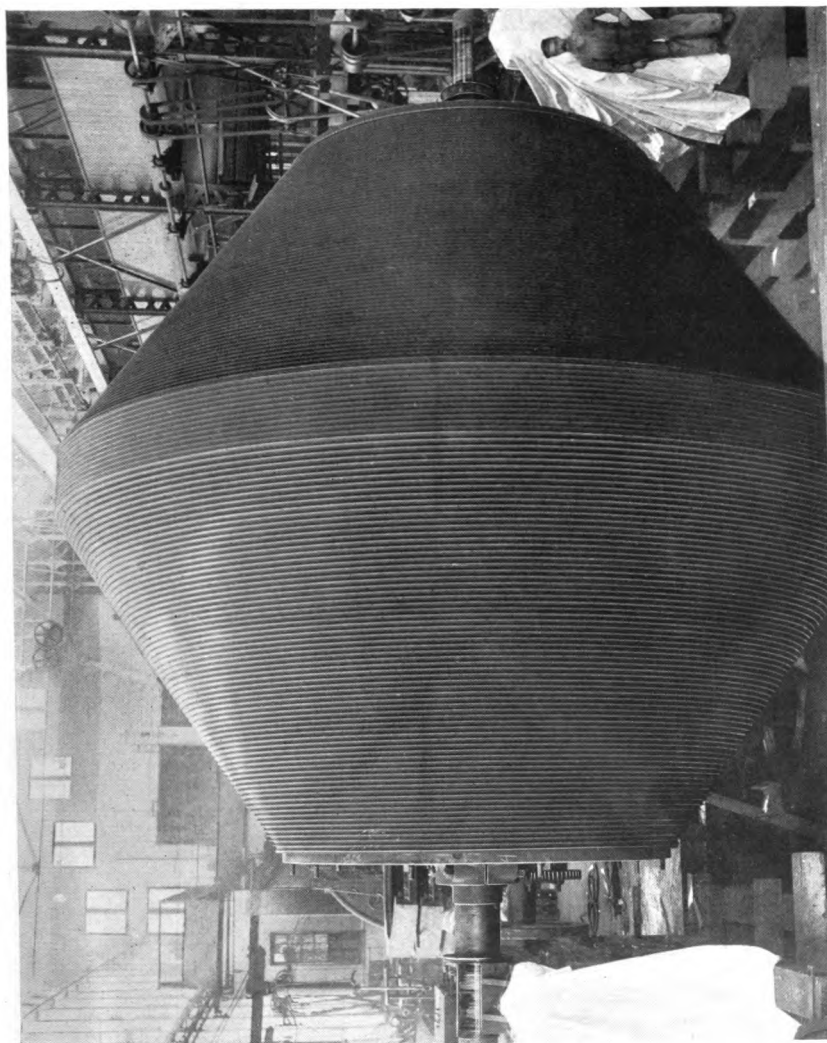


Conical Drum Hoisting Engine.

## DOUBLE CONICAL DRUM

Plate 1006, on the opposite page, shows the drum for the second Conical Drum Hoisting Engine built by Fraser & Chalmers Works for the Atlantic Mining Company.

This Hoisting Engine is similar to the first one built for the same Company (see page 47), but is larger in every respect. The drum is 12 ft. small diameter and 25 ft. 6 in. at center by 25 ft. 5 in. face. The cylinders are 24 in. by 60 in. and the capacity is 7000 pounds of ore hoisted at an average speed of 3400 ft. per minute, up an incline of 55 degrees from the horizontal, 4000 feet in length.



Double Conical Drum for 24 In. x 60 In. Corliss Hoisting Engine.—Built for the Atlantic Mining Co.

## CONE DRUM HOISTING ENGINES

Built for Adventure Consolidated Copper Co.,  
and Baltic Mining Co.

In addition to the hoists shown in this catalogue, we have now under construction two double cone drum hoisting engines for The Adventure Consolidated Copper Co., and one for the Baltic Mining Co. The hoists for the Adventure Cons. Copper Co. are of the double cone drum duplex Corliss Direct Acting Hoisting engine type, steam cylinders 24 in. diameter by 60 in. stroke, driving a double cone drum 10 ft. diameter and 13 ft. 8 in. diameter at large end, grooved for  $1\frac{1}{4}$  in. rope, each half of the drum to 2000 feet of rope. Drum is fitted with a single post brake 15 ft.  $4\frac{1}{2}$  in. diameter by 12 in. face. This brake will be of the parallel motion type operated by means of an auxiliary steam cylinder fitted with oil check. The reversing motion will be of the Allen Straight Link type operated by means of auxiliary steam engine. Engine frames are constructed so as to have a bearing along the entire length of the frame, thus making an extremely rigid construction. Each end of drum is fitted with a rope take-up so that the length of rope in use can be varied. This take-up is entirely independent of the drum and is very accessible. The throttle valve used on these hoisting engines are of a special balanced design, the valve being so perfectly balanced that it can be operated with ease by means of hand lever, and at the same time is absolutely tight. Each of these hoisting engines is to have a capacity of total load of 24900 lbs. hoisted at a speed of 2000 ft. per minute up a shaft having an inclination of 45 degrees from the horizontal.

The hoist we are building for the Baltic Mining Co. is practically a duplicate of the above described engine, with the exception that the drum will be 10 ft. diameter at small end and 15 ft. diameter at center. This hoisting engine will have a capacity of maximum gross load of 19000 pounds, hoisted at a speed of 2000 feet per minute up a shaft at an incline of 73 degrees from the horizontal.



## HOISTING FOR DEEP MINES

When mining is to be done from very great depths, the problem of hoisting ore becomes much more difficult than that met with in ordinary mines. A flat rope, under such circumstances, is not very successful, owing to the great cost of repairs on such a rope. A round rope, as a rule, requires very large drums, since with deep hoisting it is not a good plan to coil the rope in more than one layer on the drum. To overcome these objections, Mr. S. B. Whiting many years ago introduced a system of hoisting by means of drums similar to those used for cable railways. According to this system the rope passes several times around two drums which, as a rule, are both driving drums. One end of the rope is made fast directly to the hoisting cage or skip, while the other end first passes around an idler sheave located on a carriage, and thence to the other shaft compartment. By means of said carriage the positions of the two skips or cages can be altered so as to suit the different levels in the shaft.

Considerable difficulty has been experienced with this system due to unequal wear of the different grooves in the drums which were filled with wood. We have of late years entirely overcome this unequal wear by using Walker's patent differential rings on the drums instead of the common wood filling. These patent rings retain their correct diameters for a very long period and have given the most satisfactory results.

The Whiting system offers a very great advantage over any other system in that the exact maximum depth of the mine need not be known at the time when the hoisting engine is built, since, within the limits of strength, more rope can be added to suit requirements. In the case of a drum, or flat rope reel, this cannot be done because the size of the drum or reel absolutely determines the quantity of rope that can be used. In the Whiting, however, the reel does not hold the rope, but simply takes a few wraps of same and is independent of its length.

One difficulty still remained, and that was the variable dead weight of rope when hoisting from different levels. When the cage is at the bottom not only do we have to hoist its own dead

weight and that of the ore, but in addition to this the full weight of the rope, which diminishes as the cage nears the surface. On the other hand, the rope on the descending side becomes heavier as the cage goes down, and the result is that it takes a very great effort for the hoist to start the cage or skip from the bottom, while as the ascending cage nears the top, the descending cage and rope may even more than balance the total weight of the former, so that the engine of the hoist has no work to do during that period. The result is of course very poor economy, and it renders it almost impossible to use compound engines, which system is now in such universal use for ordinary mill engines.

In order to overcome this difficulty, a "tail rope" has been introduced, same being a rope of the same size and weight per foot as the main hoisting engine. The two ends of this rope are fastened to the bottoms of the two skips, and at the bottom of the shaft the rope passes around a sheave placed in guides or on a carriage, according to circumstances. This tail rope absolutely counterbalances the hoisting rope, while one skip exactly balances the other skip. The load on the engine, therefore, at all times is only the amount of ore that is being hoisted, irrespective of either weight of rope per foot, weight of skip or depth of mine.

This is of much greater advantage than would at first sight appear. It allows the use of the smallest possible engine. The engine can be proportioned for the highest economy, since the work is constant. A further advantage, which in many cases is the greatest, lies in the fact that the engine in a great measure becomes universal; that is, that identical engines can be used for any depth of mine up to the limit of strength of engine and rope. It often happens that one mining company operates a number of separate mines, or, at least, separate shafts, and the great advantage of having a hoist which can be used equally well at any of these mines, is apparent. It was these considerations which led to the adoption of this system for the Rand Mines, Johannesburg, South Africa, after they had tried almost every conceivable system of hoisting that had been devised. At these mines the Whiting system had been used, not only for hoisting rock from completed shafts, but deep shafts have been successfully sunk with such engines, during which period, of course, the tail rope could not be used to advantage. In some cases, however, it may be preferable to employ straight drums of small diameter for sinking

purposes, these drums temporarily taking the place of the Walker drums.

In the Whiting hoists both winding drums are positively driven by the engine. The first drum is driven directly by the main connecting rods, while the second drum is driven by means of a pair of parallel rods similar to those used on locomotives. Owing to the slightly inclined position of the second drum shaft, these parallel rods, however, have to be made with a simple compensating device to avoid binding. In this manner both drums become driving drums and the greatest possible amount of driving friction on the rope is obtained. Only one of the driving drums needs to be provided with a brake wheel, since the brake power is transmitted through a shaft and through the before mentioned parallel rods to the other drum just as effectively as if a separate brake had been provided for it.

It is evident that the engine part of such a hoist can be varied to suit conditions and circumstances. In most cases we would advise the use of a cross compound Corliss engine with one high pressure and one low pressure cylinder. Our illustration shows a double tandem compound Corliss engine, which, at the expense of simplicity, offers the advantage of absolutely uniform starting moment on the two cranks under any condition of load. Where economy of first cost is of more importance than economy of running, a plain pair of high pressure cylinders may be used instead of compound. It is also quite possible to arrange this engine as a four-cylinder triple expansion, though in most cases we think it will be found that the compound type answers all requirements for economy.

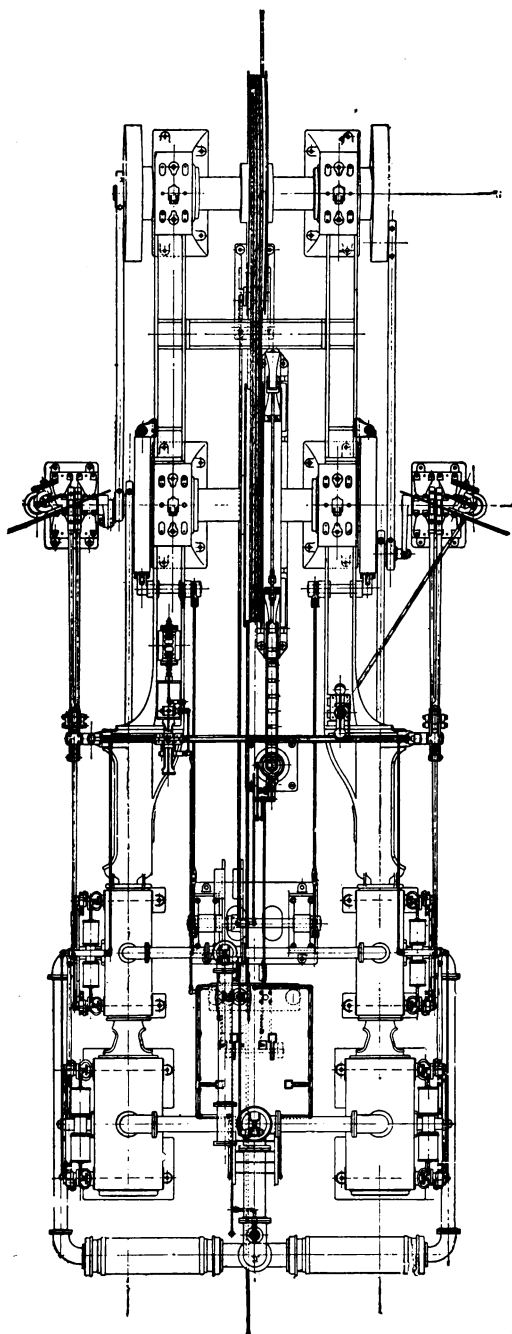
The adjustment for different levels is effected by means of the take-up gear, consisting of (a), a sheave placed on a carriage, and (b), of winding machinery for shifting this carriage along its track. The track for this carriage is very wide, and the sheave is placed preferably in a horizontal position. While hoisting this carriage is clamped to the track, and is in addition held by means of the rope by which it is adjusted. This rope may run over a tail sheave at the end of the track from which it is led to the winding engine, which may then be located in the engine room with main hoist. This winding engine consists of a drum driven by a very powerfully geared engine, because the strain on this rope is considerable. The length of track required for this take-

up gear is just one-half of the length of adjustment required in the mine, so that if it is desired to vary the position of the cage in the shaft 1000 feet, it will be necessary to have a track 500 feet in length.

On page 58 we illustrate a modification of this system which, under some conditions, may be preferred to the Whiting hoist. This hoisting engine has one large drum keyed to the crank shaft. One rope is fastened to one end of this drum, and the other rope to the other end in such wise that one rope will always wind on while the other winds off.

One of these ropes is taken directly to the head gear while the other is first laid over a take-up gear similar to that used for the Whiting system. From this it will be seen that exactly the same advantages are to be gained by this system as by the Whiting, with the single exception that this drum hoist cannot be used for a greater depth than that for which its drum is built. Offsetting this disadvantage is found the advantage of having both ropes positively fastened to the drum so that in case an accident should happen to one rope, only the skip on this rope is dropped, and not both, as would be the case in Whiting hoist. In other respects the description of the Whiting system applies, and so far as economy is concerned, one system stands just as high as the other. With either system we always furnish an automatic governor which controls the cut-off and insures a uniform speed. This governor is so arranged that it will automatically throw the cut-off gear out of action while the hoist is being slowed down, so that in all cases the engine may be left in the best possible condition for starting up again after it is stopped.

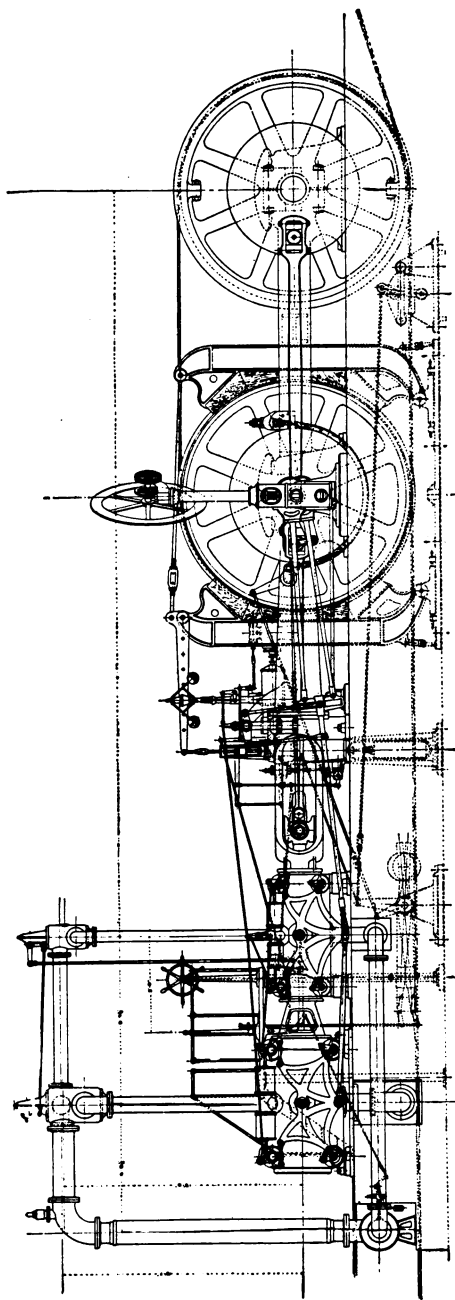
PLATE 1096.



PLAN.

Hoisting Engine—(Whiting System).

PLATE 1095.

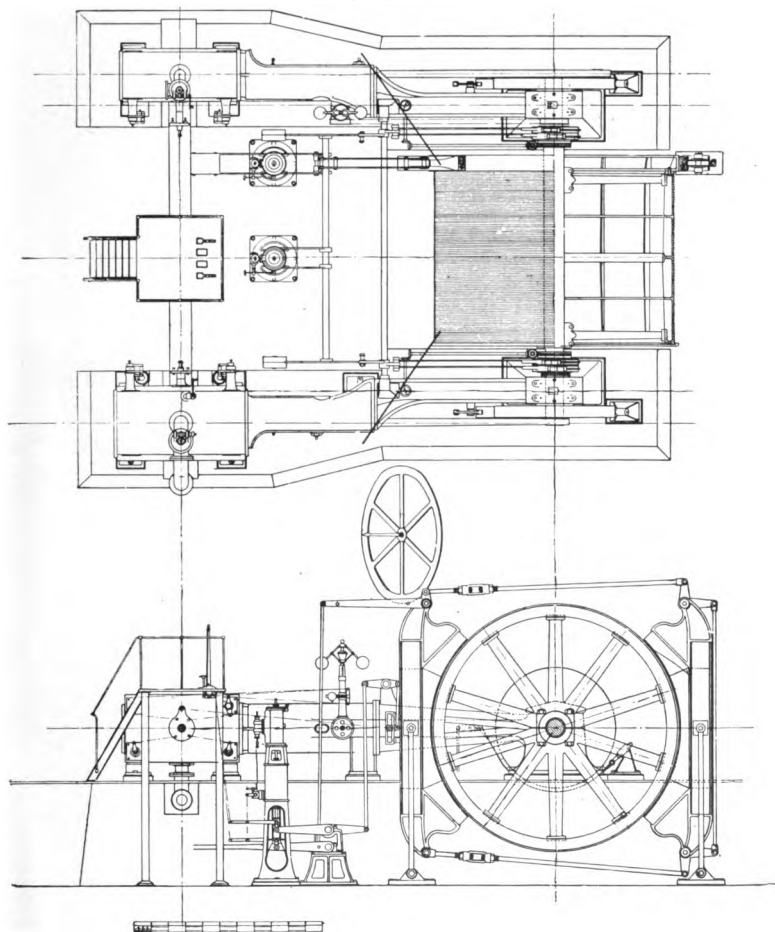


ELEVATION.

Hoisting Engine—(Whiting System).

ALLIS-CHALMERS CO., CHICAGO.

PLATE 1094.



Compound Direct Acting Corliss Hoisting Engine.

## WALKER'S PATENT DIFFERENTIAL ROPE DRUMS

Plate 1270 on opposite page shows a "Walker" Patent Differential Rope Drum such as we use on hoists of the "Whiting" type.

It has been found that when a driving rope makes a number of wraps around grooved solid drums each groove will wear down at a different rate from the others; this necessitating periodical turning out of the grooves and the ultimate replacing of the entire drums. Furthermore while the drum is running with the grooves of varying diameters tremendous strains are set up in the rope and great wear of same results in consequence of the slip, due to the difference in the length of the circumference of each groove. To eliminate these objections the "Walker" Differential Drum was devised. Each groove of this drum is turned in an independent ring (usually of forged iron) which ring is free to rotate on the drum center, thus equalizing the tension on the different wraps of the drum. At the same time with a proper number of rings, the friction of one against the other, and of all upon the cast iron center is sufficient to transmit the entire power the rope will carry. To prevent cutting, provision is made for a slight lubrication of the bottom and sides of the rings. A covering plate is provided for holding the rings in place, which plate is not shown in the annexed cut.

For high peripheral speeds such as are common with "Whiting" hoists, and under the conditions necessitating the making of the ring in halves, the rings are frequently constructed to interlock. This being an extra precaution against the accidental shearing of the joint rivets by centrifugal stresses.

Experience has fully demonstrated that differential rings are absolutely essential on a hoist of the "Whiting" type, and we, therefore use these rings on all "Whiting" hoisting engines built by us. We have also furnished them to other companies building or operating this type of machine. Among important installations using these differential rings are the mammoth hoisting engines at the Red Jacket Shaft of the Calumet & Hecla Mines which are provided with four drums 19ft.-1½in. diameter and two 7 ft. diameter, all fitted with "Walker's" Differential rings; and the five large double tandem "Whiting" hoisting engines built by us for the Rand Mines of South Africa described on pages 42 to 44 of this catalogue.



ALLIS-CHALMERS CO., CHICAGO.

PLATE 1270.



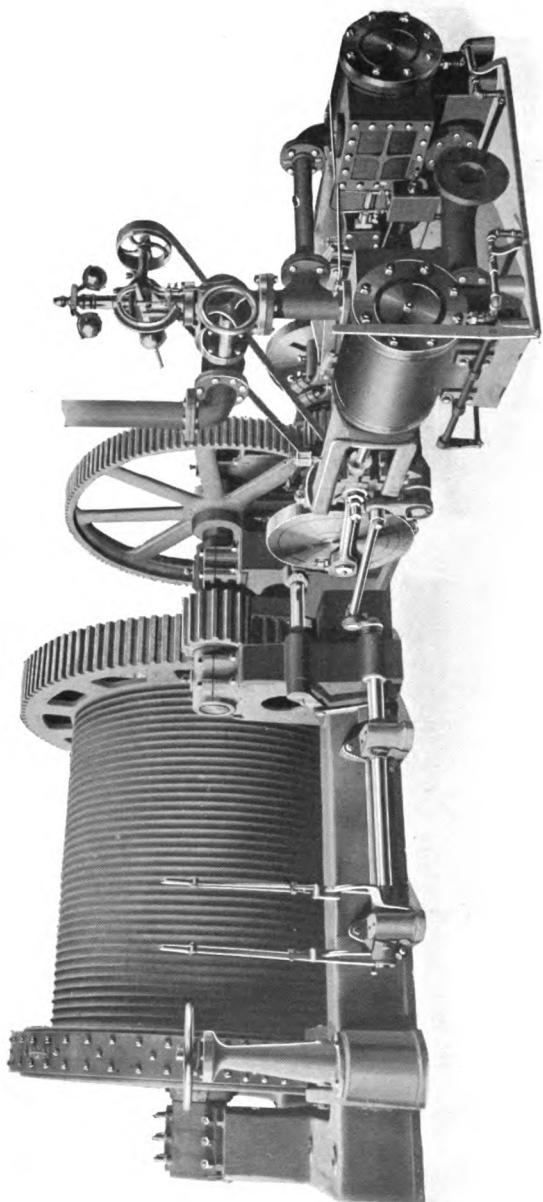
Walker's Patent Differential Rope Drums.

## FLEETING ENGINE

Plate 1268 on the opposite page illustrates a double geared single drum hoisting engine, used in connection with the Whiting hoists illustrated on pages 51 to 56. These engines are called Fleeting Engines because their duty is to fleet or traverse the movable tail-rope sheave which is used for adjusting the length of the rope; or, in other words, adjusting the depth from which main engine is to hoist. This is something that is only done occasionally, and it is therefore necessary to have a machine which can be operated at a slow rate of speed a few times a day, but the machine must be extremely heavy and substantial, as it has to lift the same load as the main engine. Speed being no object, however, it is possible to use a small geared engine. The cylinders of this engine are 10 in. diameter by 12 in. stroke, which drive by means of gearing a drum 6 ft. diameter by 6½ ft. face, grooved for 1½ in. rope, the gear ratio being 75 to 1. The drum is provided with an extremely powerful band brake operated by means of hand wheel. The crank discs are also fitted with band brakes.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 1268.



Fleeting Engine.



**REEL  
HOISTING  
ENGINES**

**Geared  
Direct Acting  
Corliss Valves  
Slide Valves**

## REEL HOISTING ENGINES GEARED AND DIRECT ACTING

The Reel Hoist is often used where it is not the intention to hoist always in balance and where no tail rope or compensating device, such as a conical drum, can be used.

The greatest weight to be lifted by any hoist is when the loaded cage is at the bottom of the shaft, consequently all the rope is off the drum or reel; but at this point the reel hoist has an advantage, since the reel begins to wind on its shortest radius. As the rope winds on the reel the total load decreases while the leverage of the rope on the reel increases, thus keeping the load on the engine nearly uniform when lifting one cage unbalanced. Another advantage of the reel hoist is that the rope always leads straight to the head sheave instead of at a considerable angle as occurs when winding on a drum.

This enables hoist to be put very close to shaft, which is a great advantage where the contour of the ground is such that expensive grading is necessary in order to prepare a site for hoist. In cold climates it is an advantage as hoisting engine and gallows frame can be under the same roof.

Reel hoists are found mostly in the western part of America, where they are in great favor. As a rule, hoisting is there done from many different levels; one car often being hoisted from one level while the car on the other deck may come from another level. Under such circumstances, it is of course out of the question to hoist in balance, and the flat rope reel hoisting engine becomes very convenient.

Fraser & Chalmers Works have built a great variety of reel hoisting engines, both direct acting and geared, driven by Corliss, Piston and Slide Valve Engines, and for large as well as for small loads.

On the following pages are given illustrations of these various types.

## SINGLE GEARED, DOUBLE REEL HOISTING ENGINE

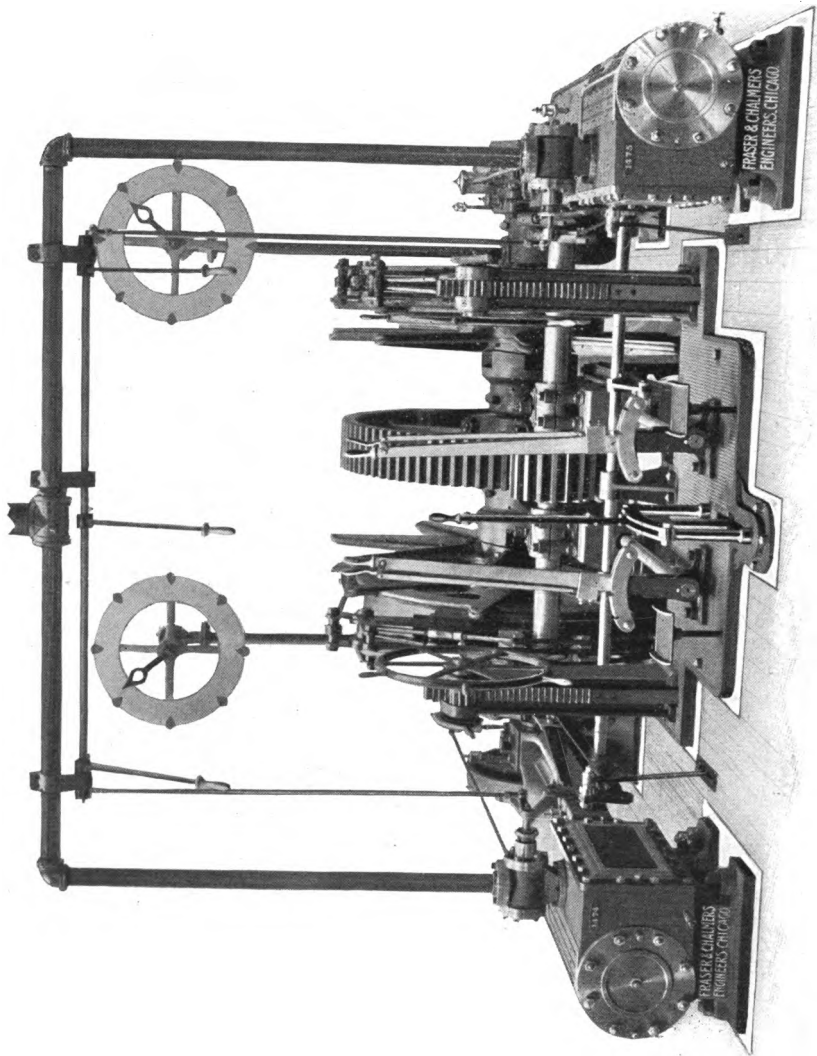
Plate 1056 on page 66 and Plate 1057 on page 67 illustrates a Double Reel, Single Geared Hoisting Engine built by Fraser & Chalmers Works for the Diamond Mine. The cylinders of the engine are duplex, 10 in. diameter by 16 in. stroke, with slide valves and link motion reversing gear.

The brakes are of the post style and are applied by means of hand wheels with rack and pinion. The hoist is also equipped with crank brakes operated by pedals. Jaw clutches drive the reels, and each reel has a dial indicator positively driven from the reel hub by means of screw and worm, for showing position of the cages.

The reels are 30 in. diameter at center and are each suitable for holding 800 feet of 3 in. x  $\frac{3}{8}$  in. flat rope.

THE OUTSIDE ARM OF THE REEL AND THE BRAKE RING ARE CAST IN ONE PIECE, THUS MUTUALLY STRENGTHENING THESE PARTS AND PRODUCING A COMPACT AND EFFICIENT HOISTING ENGINE. PLATE 1057 IS A VIEW OF THE CRANK END OF  
•THE SAME HOIST AND SHOWS THE REELS, BRAKES, ETC., MORE IN DETAIL.

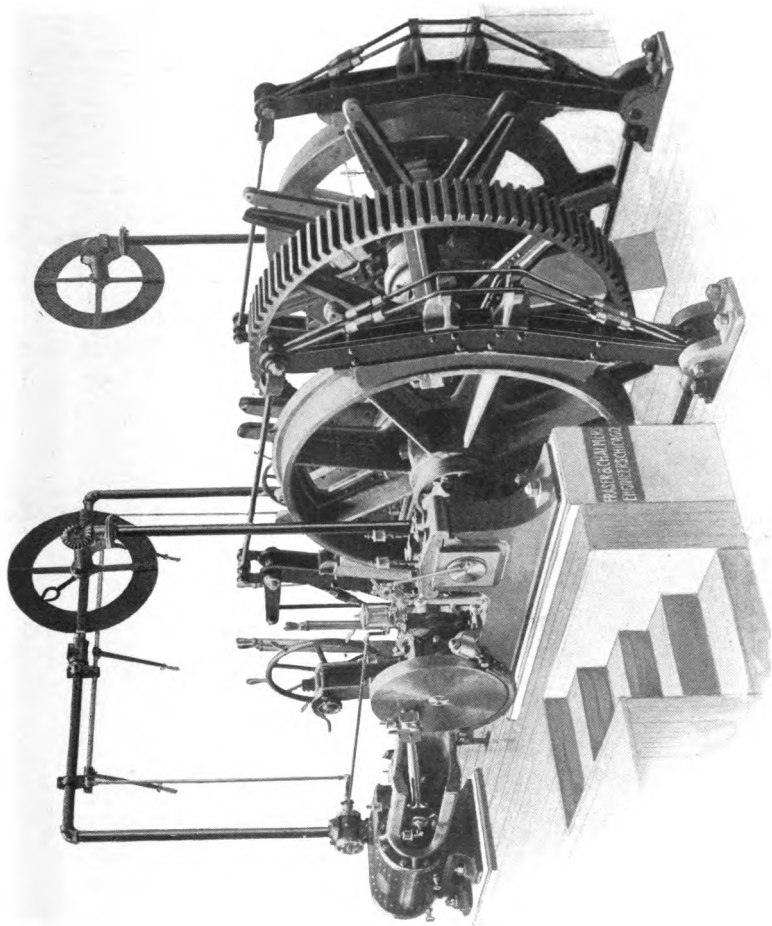
PLATE 1056.



Double Reel, Single Geared Hoisting Engine.—Cylinder End.



PLATE 1057.



Double Reel, Single Geared Hoisting Engine.—Crank End.

## DOUBLE REEL, DOUBLE GEARED HOISTING ENGINE

Plate 1064, on opposite page, illustrates a Double Reel, Double Geared Hoisting Engine built by Fraser & Chalmers Works for the Noriega Brothers.

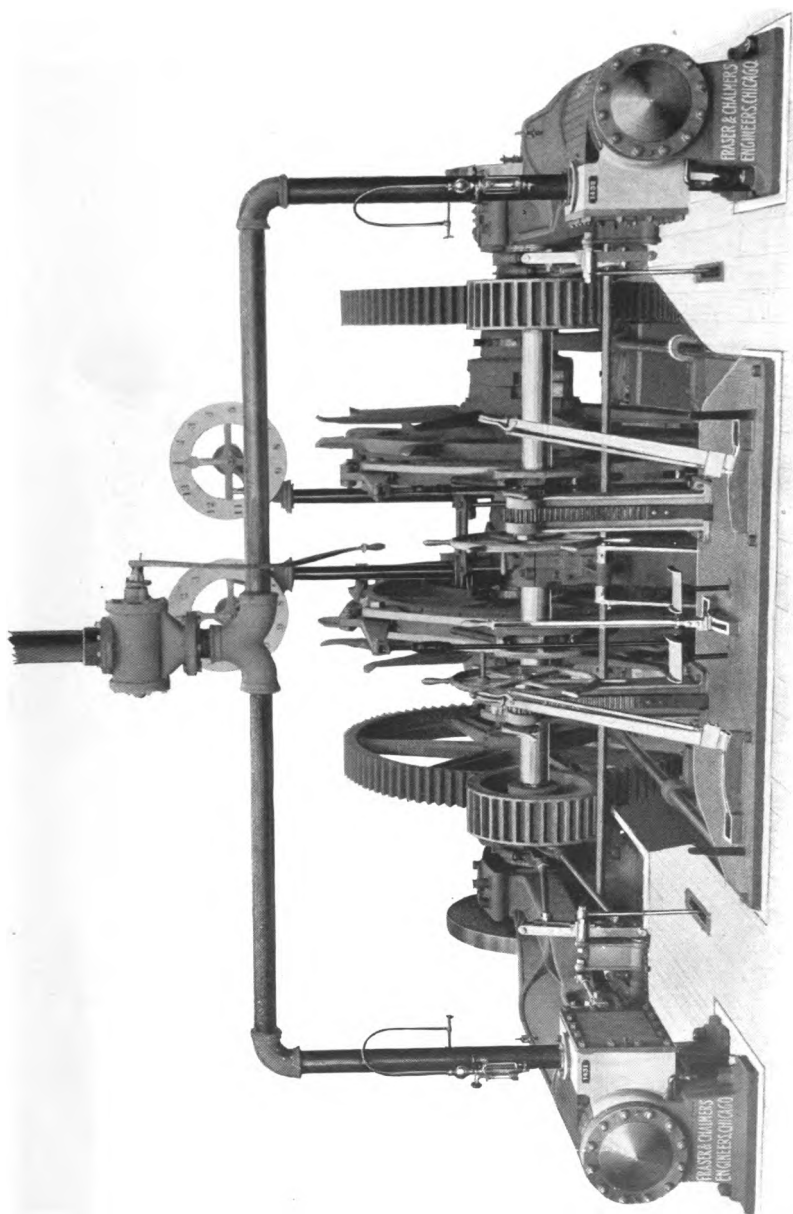
This hoist is very similar to the one just described, being driven by Duplex Slide Valve Engines, 14 in. x 24 in., and operated in practically the same manner. It differs, however, in that it is provided with two pairs of driving gears instead of one, and also a center bearing.

Each reel is 42 in. diameter at center and will hold 1,300 feet of 3 in. by  $\frac{3}{8}$  in. flat rope.

THIS HOIST WILL RAISE A TOTAL LOAD OF 6,800  
LBS. FROM A DEPTH OF 1,300 FT. AT A SPEED OF  
ABOUT 500 FT. PER MINUTE.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 1064.



Double Reel, Double Geared, Hoisting Engine.

## DIRECT ACTING DOUBLE REEL HOISTING ENGINE

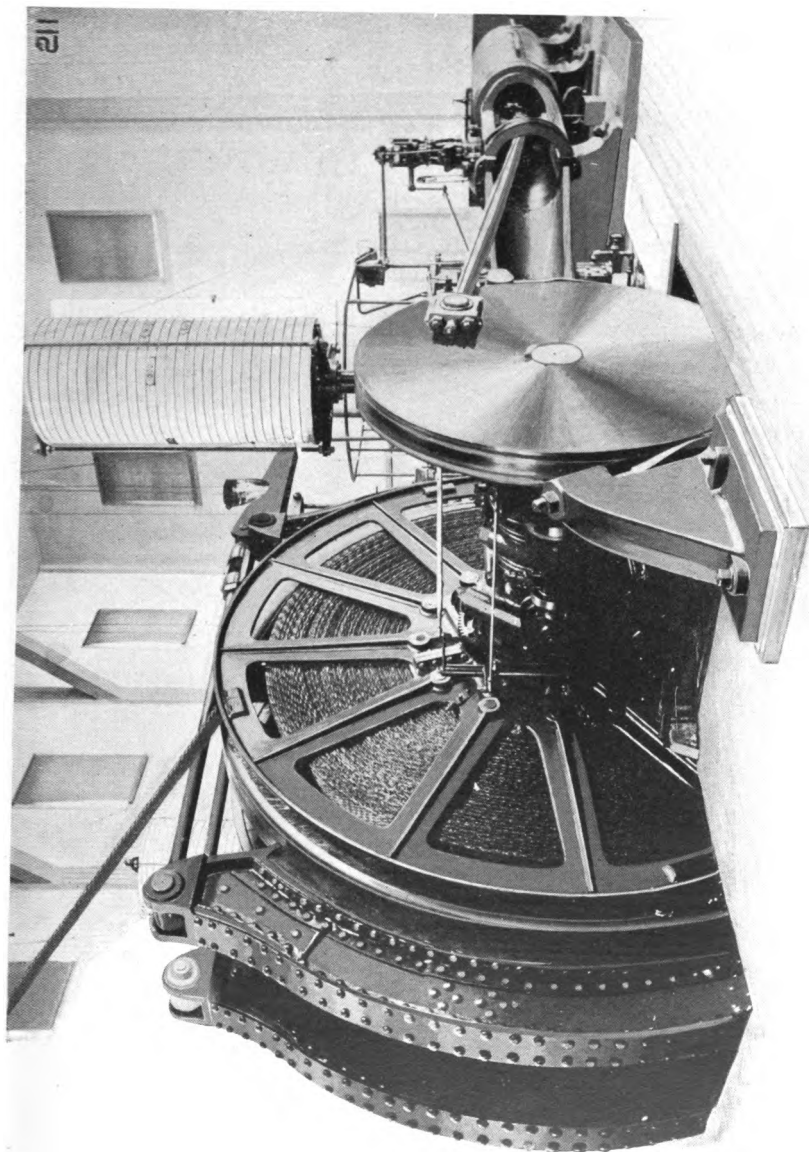
The photograph of the hoist shown by Plate 1065, on opposite page, was taken when the hoist was erected at the mine, and shows the reel wound nearly full.

This engine was built by Fraser & Chalmers Works for the Bi-Metallic Mine and is equipped with unusually strong post brakes and crank brakes, as can be plainly seen from the illustration. The hoist is operated from a raised platform and spiral indicators show position of the cages. The engine is direct acting and is driven by Duplex 22 in. x 60 in. Piston Valve Cylinders. Brakes, clutches, and reversing links are steam operated. The reels are 6 ft. diameter at the center and will each hold 3,000 feet of 6 in. x  $\frac{1}{2}$  in. flat rope. Overwinding is prevented by an automatic safety stop.

THIS HOISTING ENGINE WILL RAISE A TOTAL  
LOAD OF 22,000 LBS. FROM A DEPTH OF 3,000 FT.  
AT A SPEED OF 2,000 FT. PER MINUTE.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 1065.



Direct Acting, Double Reel, Hoisting Engine.

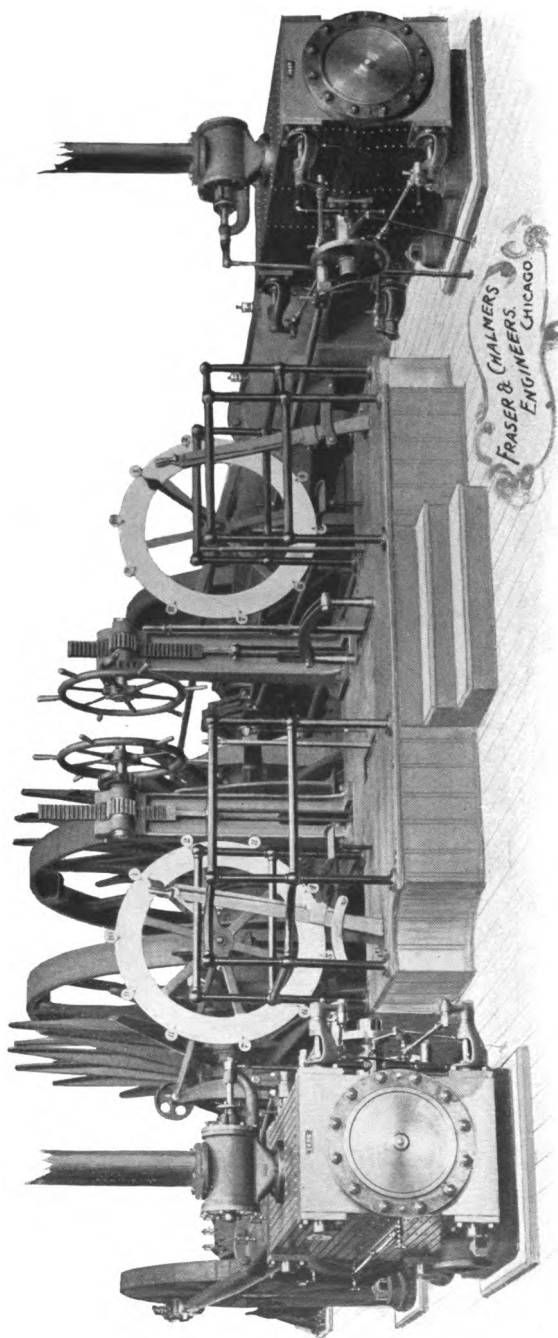
## DOUBLE REEL, DIRECT ACTING HOISTING ENGINE

Plate 1059, on opposite page, and Plate 1060, on page 75, illustrate the Double Reel, Direct Acting Hoisting Engine built for the Homestake Mining Company by Fraser & Chalmers Works. It is hand operated throughout from a slightly raised platform, has duplex Corliss cylinders 20 inches in diameter and 60 inches stroke.

The diameter of the reels at the center is 5 feet and each will hold 1500 feet of  $5\frac{1}{2} \times \frac{1}{2}$  in. flat rope.

PLEASE NOTE THAT THE CAPACITIES OF HOISTS GIVEN BY US IN THIS CATALOGUE, OR WHEN QUOTING ON SPECIAL DESIGNS, INDICATE (UNLESS OTHERWISE STATED), THE MAXIMUM LOADS UNDER WHICH THE ENGINES WILL START WITH THE CRANKS IN ANY POSITION.

PLATE 1059.



Double Reel, Direct Acting Hoisting Engine.

## DOUBLE REEL, DIRECT ACTING HOISTING ENGINE

Plate 1060 is a view of the crank end of the hoist illustrated on page 75 and shows clearly the clutch and brake mechanism.

The clutches are of the jaw type mounted on an octagonal shaft; the use of feathers on the shaft for this style of clutch, although quite common, is not to be preferred as the strain and concussion when "clutching in" is very severe.

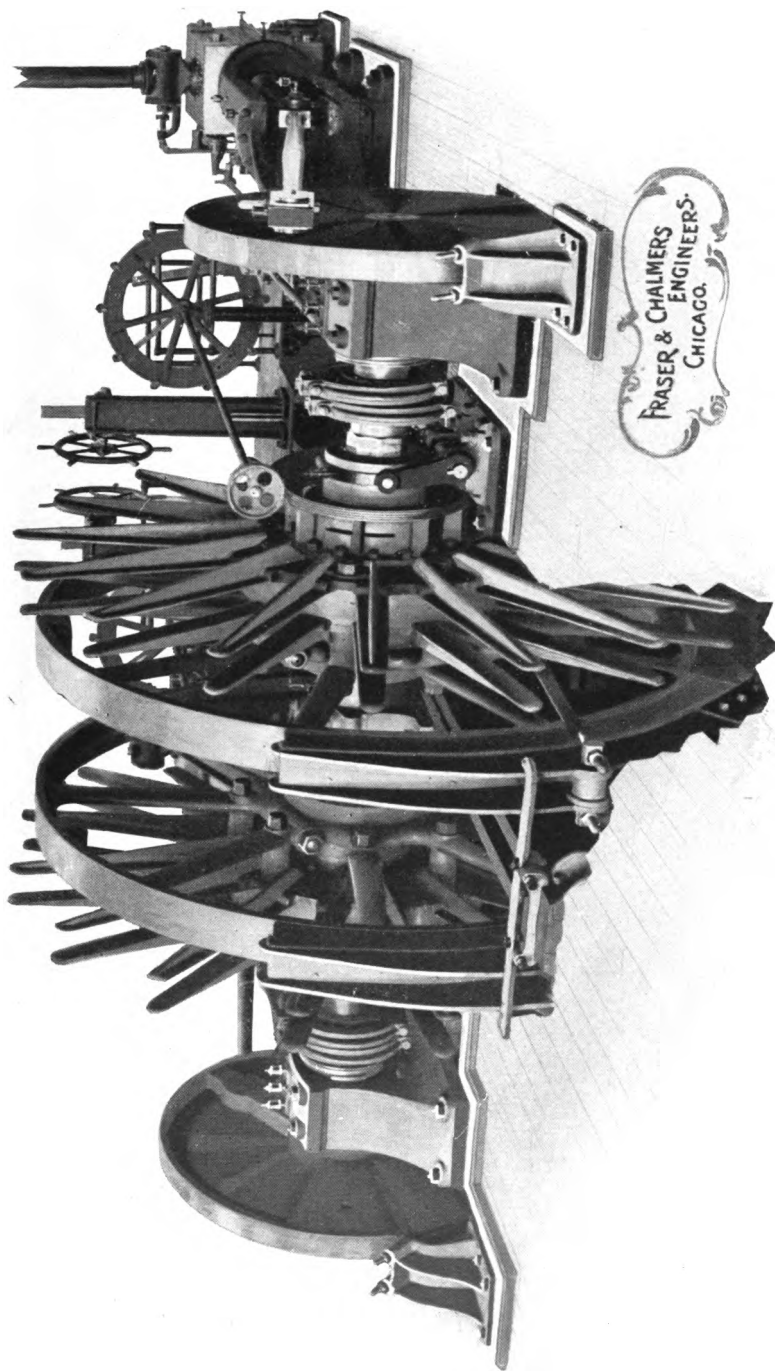
The plate also shows the worm gear indicator drive. It will be obvious that this drive is direct and positive and fully complies with the law enacted in some states regarding such devices.

WE HAVE BUILT MANY SPECIAL HOISTING ENGINES  
IN ADDITION TO THOSE HEREIN ILLUSTRATED.  
OUR PATTERNS INCLUDE A GREAT VARIETY OF  
TYPES, COMBINATIONS AND SIZES,—MORE THAN  
300—WHICH ENABLES US TO PRODUCE HOISTING  
MACHINERY PERFECTLY ADAPTED TO THE SERV-  
ICE REQUIRED.



ALLIS-CHALMERS CO., CHICAGO.

PLATE 1060.



Double Reel, Direct Acting Hoisting Engine.

## DUPLEX, DIRECT ACTING, DOUBLE REEL HOISTING ENGINE

Plate 1061, on opposite page, shows the crank end of a Duplex, Direct Acting, Double Reel Hoisting Engine built by Fraser & Chalmers Works for the Centennial-Eureka Mining Company.

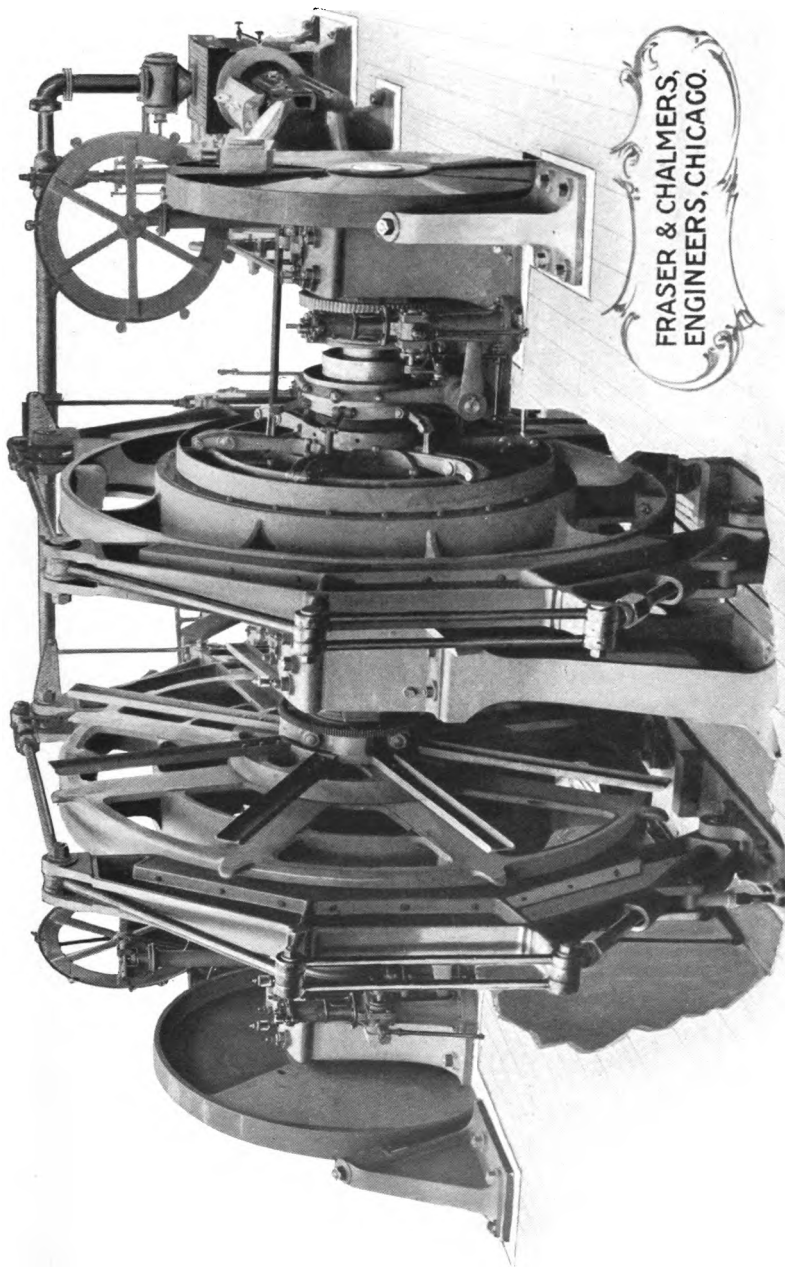
The cylinders are 20 inches in diameter by 60 inches stroke and have link motion reversing gear of the Stephenson type. The reels are 5 feet diameter at center and each capable of winding 2,500 feet of 5 in. x  $\frac{3}{8}$  in. flat rope. They are driven by friction clutches, and an automatic safety stop prevents overwinding.

The clutches, brakes and reversing gear are steam operated; the levers, together with those operating crank brakes and throttle valve, being on engineer's platform.

ALLIS-CHALMERS CO.'S PRODUCTIONS INCLUDE  
MACHINERY AND APPLIANCES FOR MINING, MIL-  
LING, CONCENTRATING, AMALGAMATING AND  
SMELTING OF ORES. INSTALLATIONS COMPLETE  
FOR TREATING ORES BY ALL APPROVED PRO-  
CESSES.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 1061.



FRASER & CHALMERS,  
ENGINEERS, CHICAGO.

Duplex, Direct Acting, Double Reel Hoisting Engine.

## DIRECT ACTING, DOUBLE REEL CORLISS HOISTING ENGINE

Plate 745, on opposite page, illustrates a Fraser & Chalmers Duplex Corliss Engine, cylinders 20 in. diameter, stroke 60 in. direct connected to a pair of reels 5 feet diameter at center for winding 2000 feet of 4 in. x  $\frac{1}{2}$  in. rope. The reels are fitted with steam operated clutches and post brakes, and the engines have steam reverse. All auxiliary steam cylinders have oil cataract cylinder arranged tandem with the steam cylinder to give an easy and steady motion. A large and heavy pillow block is provided for the center bearing of the crank shaft. This pillow block is of the same design and has the same provision made for taking up the wear that the engine pillow blocks have.

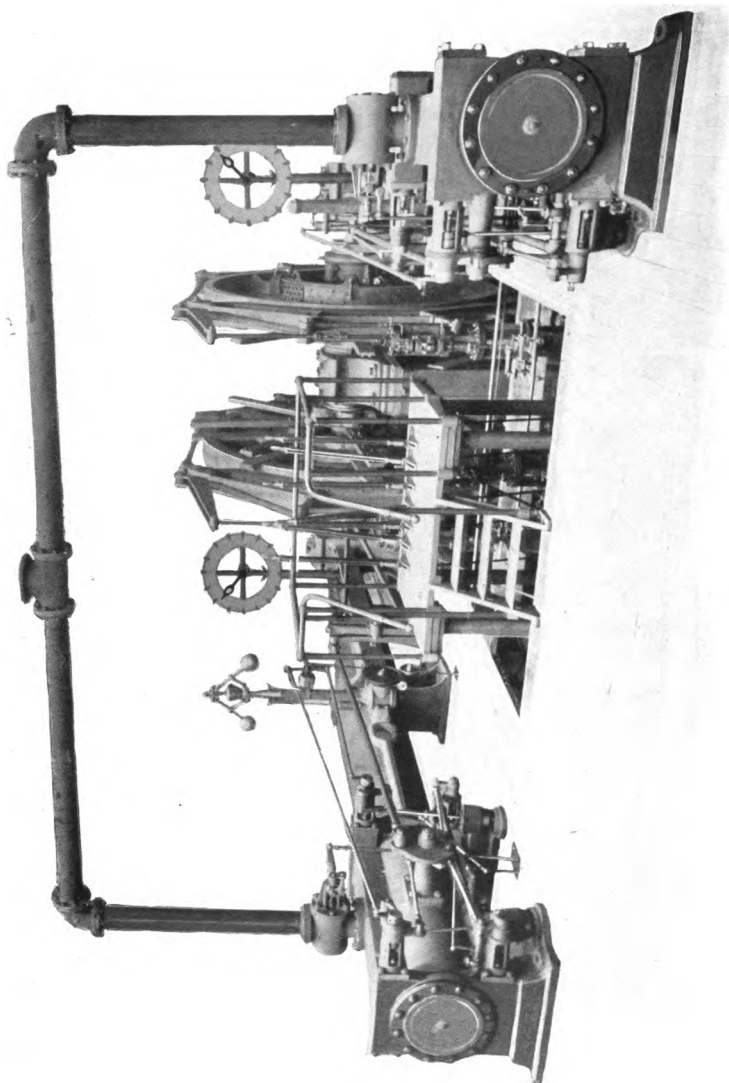
The engraving was made from a photograph taken of a hoisting engine built by Fraser & Chalmers Works for The Helena-Frisco Mining Company, Idaho.

Since this hoisting engine has been in operation we have received orders for duplicates from the Standard Mining Co. and the Consolidated Tiger & Poorman Mining Company. All of these companies are in the same district, and the later orders were due to the eminently satisfactory operation of The Helena-Frisco Co.'s hoisting engine.

We have recently installed two hoisting engines of practically the same design as this hoist but with 20 in. diameter x 48 in. stroke steam cylinders.

One of these hoists is at the Copper Queen Cons. Mg. Co., the other at the Redboy Cons. Gold Mines.

PLATE 745.



Direct Acting, Double Reel, Corliss Hoisting Engine.

## DUPLEX, TANDEM COMPOUND CORLISS HOISTING ENGINE

Plates 804 on page 82, and 1055 on page 83, illustrate an arrangement of Duplex Tandem Compound Corliss Engines directly connected to reel shaft. The cylinders of the engine are 16 inches diameter high pressure and 24 inches diameter low pressure, and the stroke 42 inches. Arrangement is made whereby high pressure steam can be by-passed into the low pressure cylinders when starting the load. The high pressure cylinders are fitted with Corliss automatic cut-off valve gear under control of a governor and the low pressure cylinders are fitted with Corliss valves having fixed cut-off. Each cylinder has a separate throttle valve, all of which are simultaneously operated by a steam cylinder from the engineer's platform.

The reels are 4 ft. diameter at center and are suitable for holding 2700 feet of 5 in. x  $\frac{3}{8}$  in. flat rope. They are fitted with band friction clutches and post brakes, operated by steam cylinders. The reversing gear, which is of the Stephenson type, is also operated by a steam cylinder.

Particular attention is called to the indicators. These, by means of a compensating arrangement, are so constructed as to move the hands at a speed proportionate with that of the rope. This very materially lessens the liability to overwind.

Hoisting engines of this type are particularly recommended for use in localities where fuel is expensive and the duty is continuous. Experienced mining men who have made the subject of hoisting a study, are also adopting them for use at mines where fuel costs but from \$2.00 to \$2.50 per ton.

This engine is able to handle the load unbalanced, starting from any level and with the cranks in any position, while the automatic cut-off of the steam by the governor enables the engine to work economically when hoisting in balance.

By referring to plate 804, it will be seen that the operating levers are very conveniently located on the engineer's platform on the floor level, enabling the engineer to control all operations without moving from his position.

The economical advantages of compound hoisting engines are best obtained where there is continuity of operation.

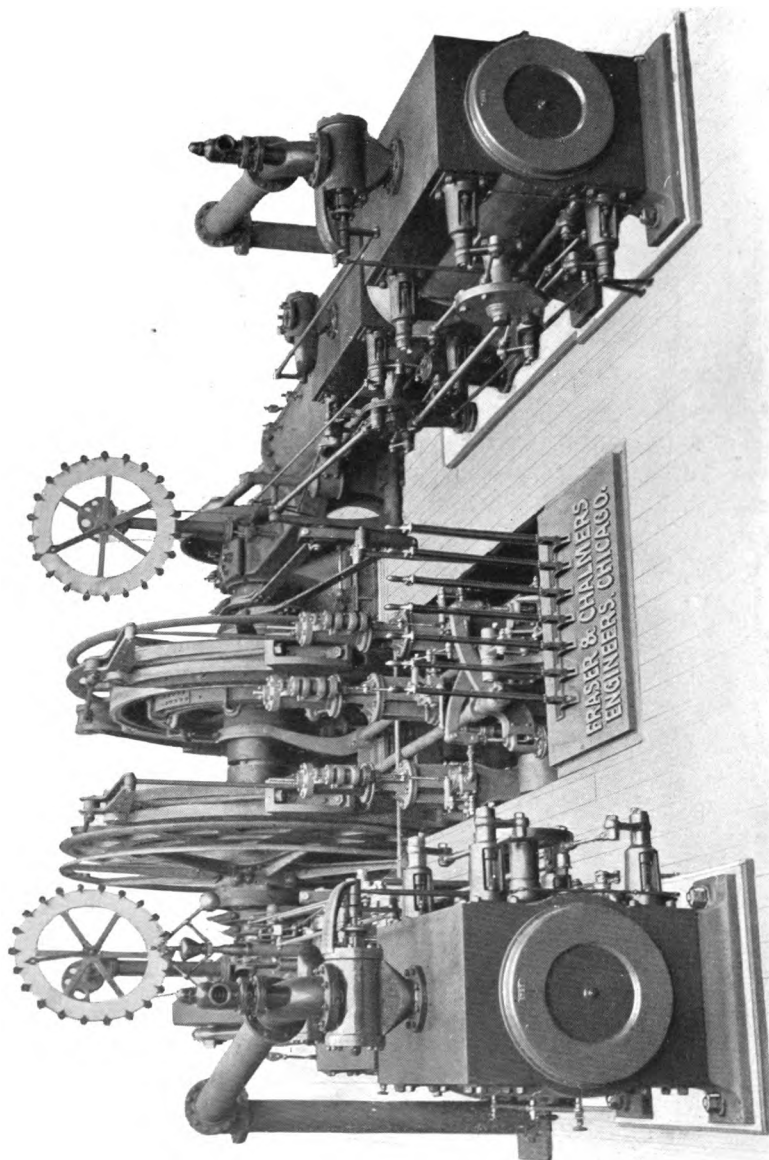
Plate 1055 is a view of the crank end and shows more clearly the compensating device attached to the indicators, also the details of the reels, band friction clutches, post brakes, etc.

The engravings were made from photographs taken in our shops of a hoisting engine built for the Grand Central Mining Co., Mexico. A duplicate of this engine was also built by us for the Chihuahua Mining Co., Mexico.

Compressed air in place of steam can be used for driving the above described engine, but in order to secure economical results the air should be reheated before entering the high pressure cylinder. If the air is again reheated before entering the low pressure cylinder, this engine gives remarkable economy.

WE ESPECIALLY RECOMMEND THE DUPLEX TANDEM COMPOUND ENGINE IN PREFERENCE TO THE CROSS-COMPOUND TYPE, WHEN THE LOAD IS VARIABLE, AS THE FORMER STARTS MORE EASILY.

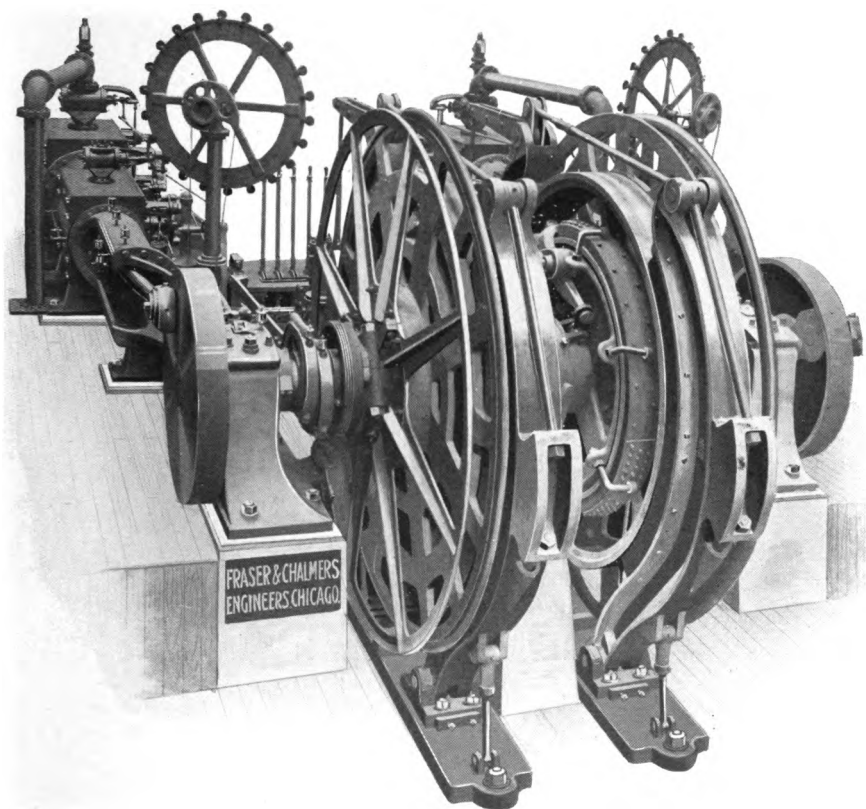
PLATE 804.



Duplex, Tandem, Corliss Hoisting Engine.—Cylinder End. (See also Plate 1055.)



PLATE 1055.



Duplex, Tandem Compound, Corliss Hoisting Engine.—Crank End.  
(See also Plate 804.)

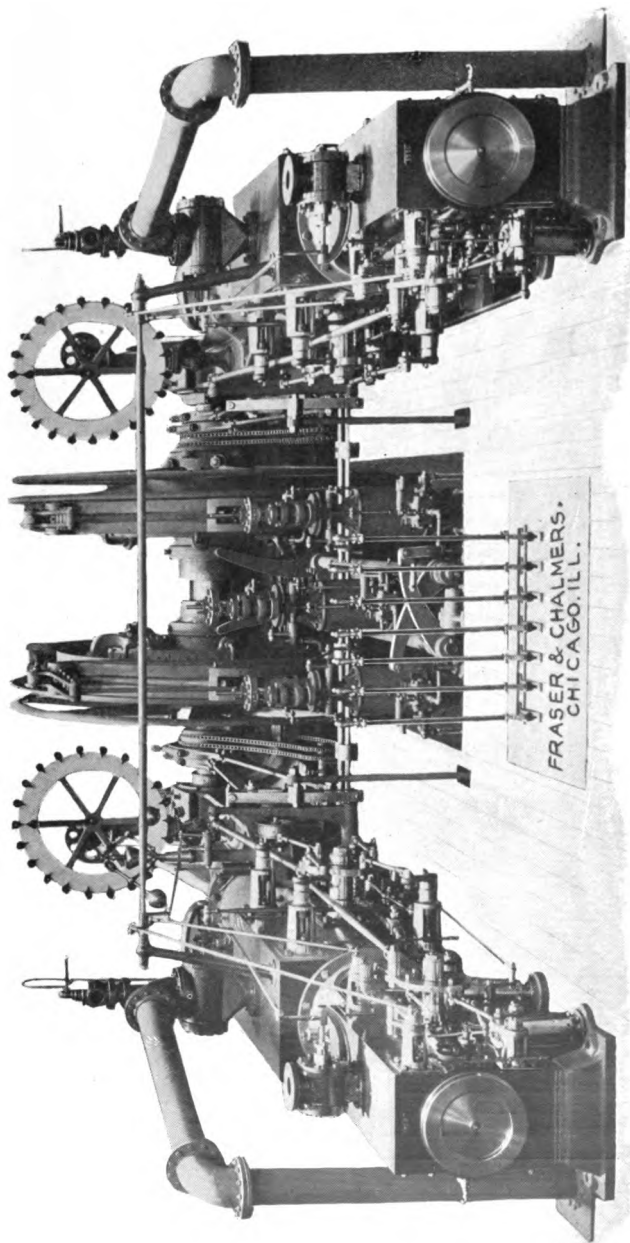
## DUPLEX, TANDEM COMPOUND HOISTING ENGINE

Plate No. 744, on the opposite page, illustrates a Duplex Tandem Compound Corliss Hoisting Engine, having high pressure cylinders 14 inches diameter and low pressure cylinders 22 in. diameter by 42 in. stroke. The reels are each of sufficient size for winding 2700 feet of 4 in. by  $\frac{3}{8}$  in. flat rope. They are fitted with band friction clutches and post brakes of our standard design. An automatic safety stop is connected to the reels to prevent overwinding. The hoist is operated by steam throughout, the auxiliary steam cylinders being in turn operated by hand levers on the engineer's platform.

The engraving was made from a photograph taken of a hoisting engine built by Fraser & Chalmers Works for the Negociacion de Santa Ana, Mexico.

THE PRESTIGE GAINED BY MANY YEARS OF EXPERIENCE IN BUILDING MINING MACHINERY TOGETHER WITH OUR UNEQUALLED MANUFACTURING FACILITIES IS REFLECTED IN THE CHARACTER OF OUR PRODUCTIONS. FOR SEVERAL DECADES THE FIRM NAME OF FRASER & CHALMERS HAS BEEN ASSOCIATED WITH THE MORE IMPORTANT ADVANCES THAT HAVE BEEN MADE IN PERFECTING MACHINERY AND AUXILIARY APPLIANCES FOR TREATING ORES.

PLATE 744.



Duplex, Tandem Compound Hoisting Engine.—With Corliss Valve Gear.

## SINGLE CYLINDER PORTABLE HOISTING ENGINE

With Boiler and Feed Pump.

Plate 566 on opposite page illustrates a machine particularly well adapted for prospecting small mines, coal yards, ore docks, etc., where a complete, self-contained hoisting plant is required. It is substantially built and well arranged; a continuous bed-plate carrying engine and boiler. The drum is fitted with a band friction clutch operated by a hand lever, and a band brake operated by a foot lever. The bands are lined with wooden blocks, provision being made for taking up wear. Throttle, clutch and brake levers are within easy reach of operator.

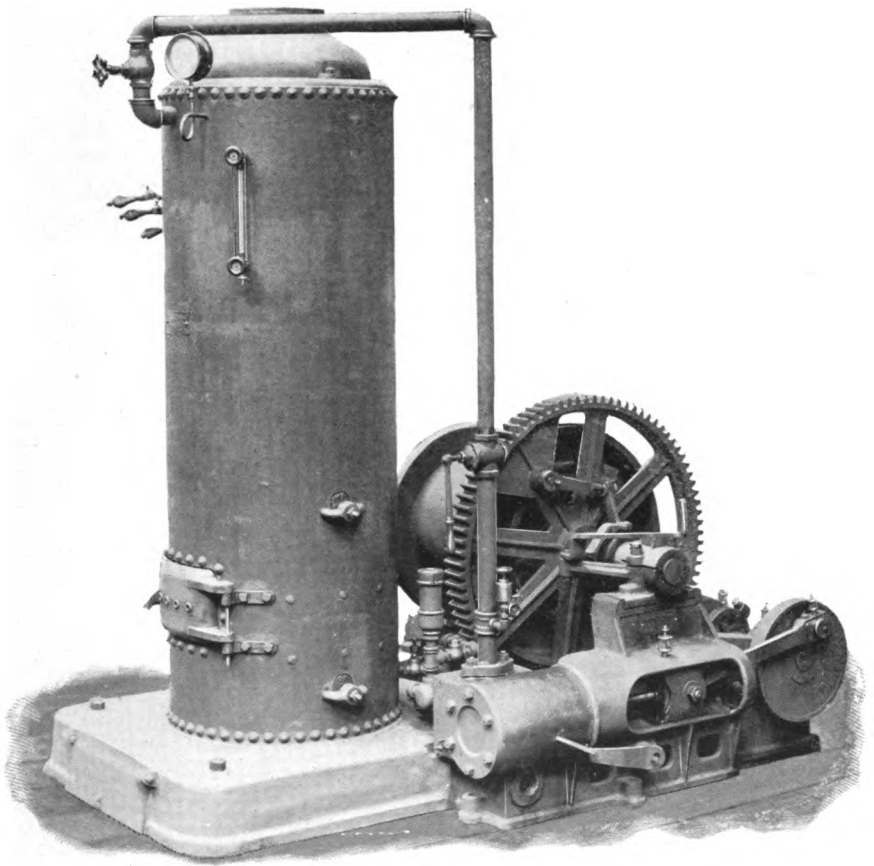
A heavy fly wheel is placed on the outer end of the crank shaft and may be used to drive other machines. The boiler shell is made of flange steel throughout and boiler is fed by a single acting pump, driven by an eccentric on the engine shaft. The hoist operates economically and requires no special foundation.

Below are given standard sizes.

Code word.....	Agitable	Agitabunt	Agitacao
Number.....	No. 0C	No. 1C	No. 2C
Dia. of cylinder.....	6 in.	7 in.	8 in.
Stroke.....	8 in.	10 in.	10 in.
Dia. of Drum.....	18 in.	20 in.	20 in.
Length of Drum.....	18 in.	20 in.	20 in.
Dia. of Rope.....	$\frac{1}{2}$ in.	$\frac{5}{8}$ in.	$\frac{5}{8}$ in.
Feet Rope in one coil.....	150	165	165
Rev. per Min.....	260	250	240
Horse Power.....	12	18	22
Gears { No. Teeth in Gear.....	89	89	89
" " " Pinion.....	20	20	20
Approx. Hoist Speed.....	275	300	286
Max. Load.....	1,200 lbs.	1,800 lbs.	2,350 lbs.
Height of Boiler.....	5 ft.	7 ft.	7 ft.
Dia. " " ".....	30 in.	30 in.	36 in.
Weight Complete.....	4,700 lbs.	7,000 lbs.	8,500 lbs.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 566



Portable Hoisting Engine with Boiler and Feed Pump.

## HORSE POWER HOIST

Plate 126 represents our Horse Power Hoist. It is especially adapted for prospecting or hoisting ore or water from moderate depths, until a mine proves worthy of installing permanent machinery, and is simple, durable and easily handled.

No stone foundation is required, as the frame is bolted down on timbers embedded in the earth, the timbers being so placed that the rope may run under or above the surface of the ground. The latter arrangement requires no pit to be drained.

The drum is provided with clutch and band brake and hoisting is under complete control of the operator at the mine shaft where the levers are located, for in this position he can operate hoist and handle buckets as well.

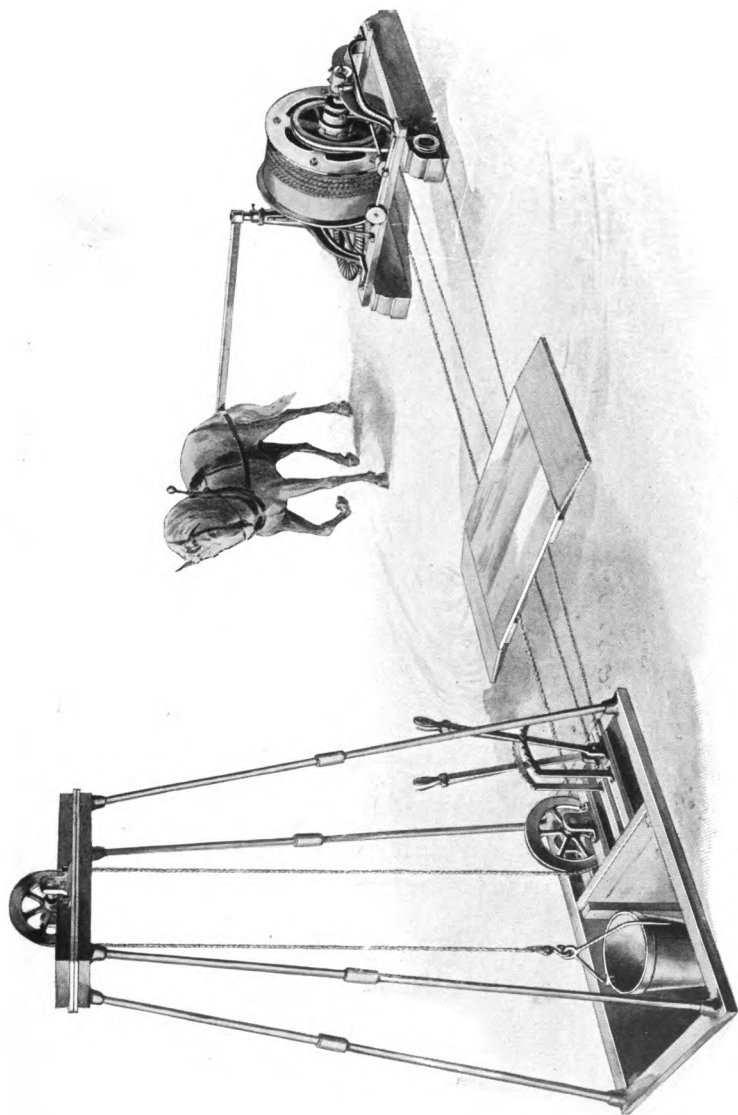
An iron gallows frame will be supplied when desired, which, with the hoist, can be sectionalized to 250 lbs. limit.

The hoist will lift a total load of 400 lbs. at a speed of 60 feet per minute at ordinary walking speed of horse. With light bucket and rope it will lift from a depth of 300 feet. Total weight of hoist, including overhead sheaves, 2400 pounds.

Plate 331, page 90, illustrates a horse gear with double sweep. It is of heavy design and four revolutions of the sweep produce 60 revolutions of the shaft. Its weight is 1500 pounds.

ALLIS-CHALMERS CO., CHICAGO.

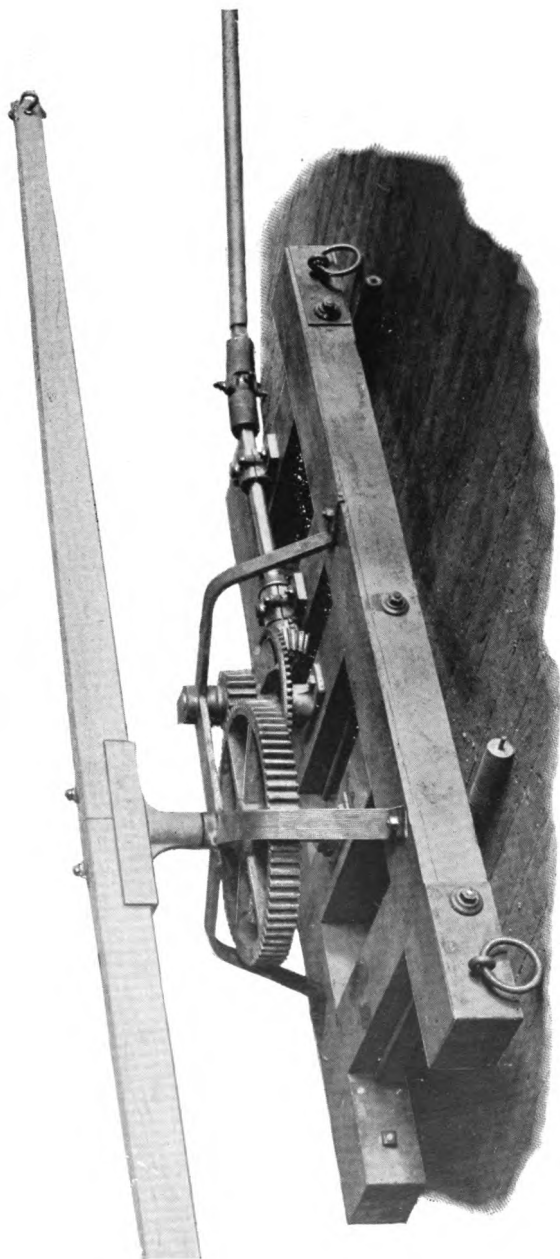
PLATE 126.



Horse Power Hoister or Whim.

ALLIS-CHALMERS CO., CHICAGO.

PLATE 331.



Horse Gear, Double Sweep.



## HAND WINDLASS

PLATE 163.

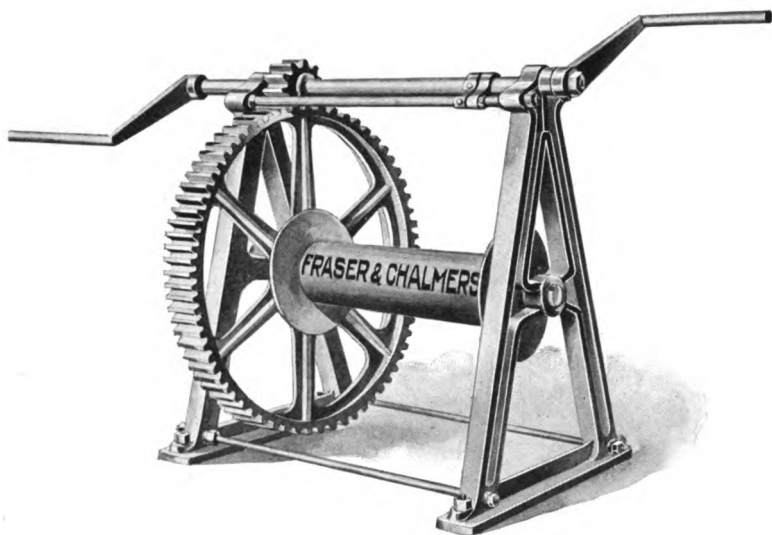


Plate 163 shows our Single Geared Hand Windlass or Hoisting Crab. It is constructed with a rigid iron frame and is provided with two cranks or handles. If preferred, this crab can be mounted on an oak frame. The capacity of the single geared windlass is from one to two tons.

For larger capacities we furnish a Double Geared Hand Windlass with iron frame and provided with two cranks or handles, geared for slow lifting with heavy loads, or for quick lifting with light loads. Capacity two to four tons.

Prices furnished upon application.

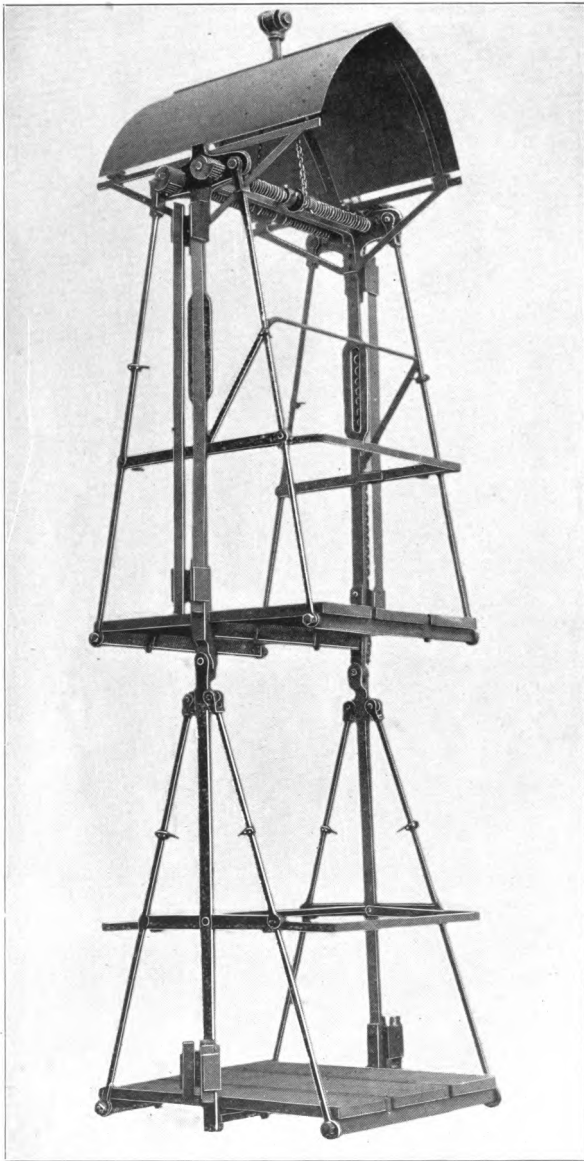


## SAFETY HOISTING CAGE

Our cages are very carefully and strongly constructed throughout of the best Swedish iron and steel. They are fitted with safety catches worked by either coil or carriage springs, as desired, preventing the possibility of the cage falling should the rope break; these catches are held away from the guides while the weight of the cage hangs on the rope, but are released and spring against the guides immediately when the strain is taken from the rope. The uprights each have a slot through which to tighten the bolts or screws in the guide timbers.

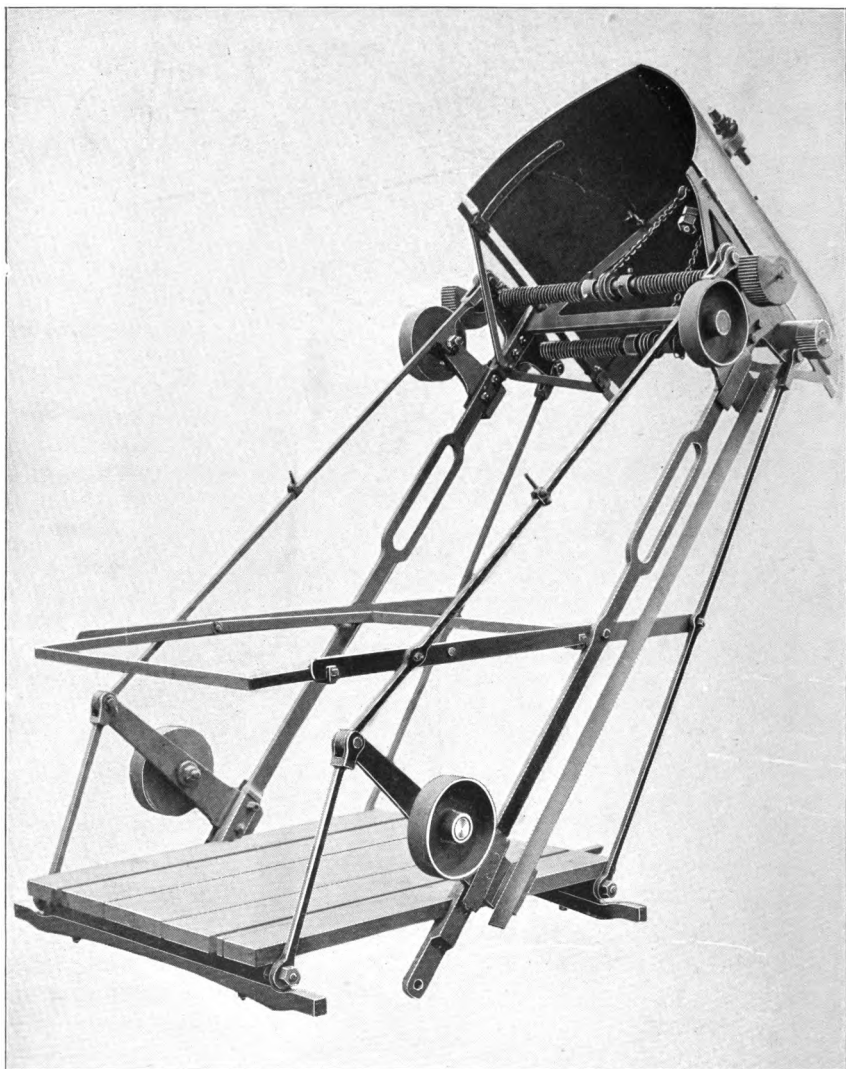
The platform is planked over and has a track built in, so that cars may be easily run off or on. A sheet steel hood or shield is attached to the top to prevent the men from being injured by anything falling down the shaft, the hood being hinged to open from the center to permit carrying long mine timbers on end.

When ordering give exact size of shaft in clear, and gauge of car track if already laid, also size of guides.



## DOUBLE DECK SAFETY HOISTING CAGE

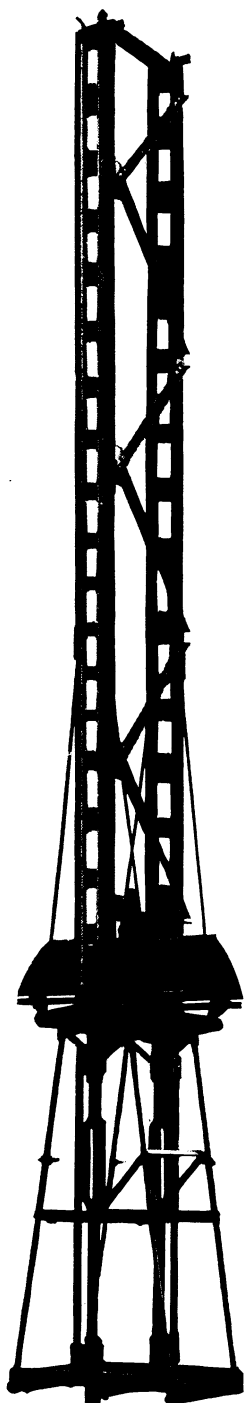
Plate No. 742 represents our Double Deck Cage. The upper deck or platform is constructed in every way like the single deck cage, but is heavier. The lower deck is suspended from the upper part of cage by pins so as to be easily removed at any time.



The above illustration shows our Standard Hoisting Cage for inclined shaft. When required, we construct this cage with adjustable platform for shafts of variable angles. The platform in such case is hinged on levers and can be adjusted by a hand lever to a level position.

Cages can be made any desired size and to suit any angle.

In ordering, or when requesting quotations, correspondents should give exact size of shaft in the clear and correct angle of shaft from the **horizontal** also gauge of car track.



## HOISTING CAGE

With Extension for use in Sinking Shaft.

When sinking a vertical shaft, the timbers cannot be carried clear down to the bottom; hence it is usual to have a bucket which can be lowered to a convenient point for loading.

The cut on this page shows a method of extending the guides of the cage so that it may be lowered below the guide timbers far enough to be readily loaded. This extension is so constructed that it will run up beyond the sheave, as the rope is attached to the cage proper. This arrangement does not necessitate special elevation of the sheave. The extension is heavy and its weight must not be overlooked when providing a hoisting engine and in choosing size of rope.

When sinking is completed, the extension can be removed, leaving an ordinary cage.

## GRAY'S CAGE CHAIRS

Gray's Patent Cage Chairs are an improvement upon the ordinary system of separate sets of chairs for each shaft level, in that their employment substitutes a single set of chairs carried by the cage in place of a considerable number of chairs, one for each level. This effects a large saving, especially in deep shafts. The Gray Chairs are also conveniently operated either from the cage or from any level of the mine, and are proved in practice to be thoroughly reliable and to satisfy all the requirements of mine shaft chairs.

In Plate 814, the chairs are shown applied to the cage of a vertical shaft.

In Plate 572 they are shown applied to the cage of an inclined shaft.

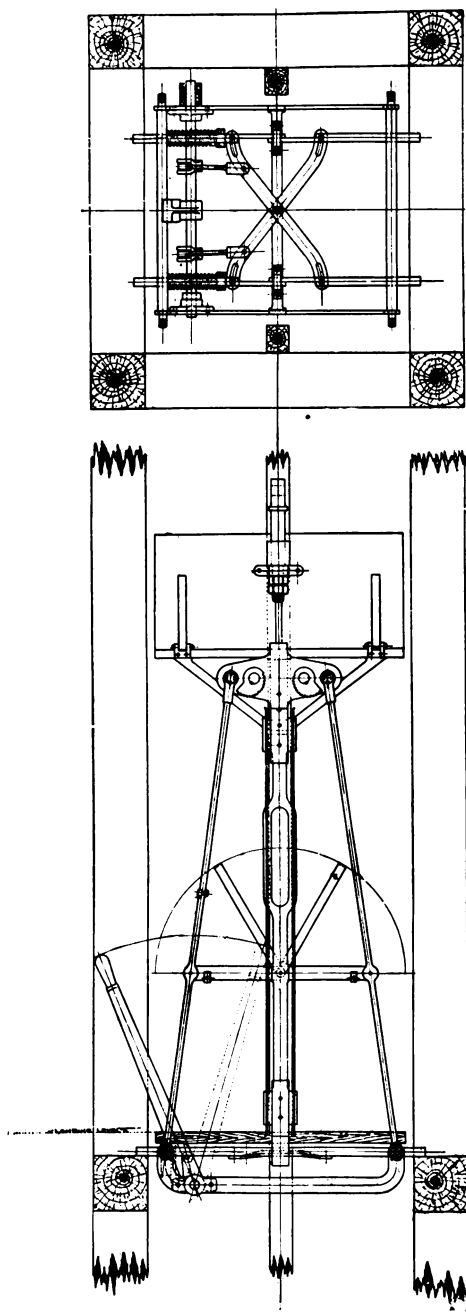
The method of operation appears clearly from the illustrations.

A lever mounted upon the floor framing of the cage when thrown inward or outward causes bars forming an extension chair to slide in or out.

When out, these bars rest in notches or upon wall plates in the shaft. The sliding bars are properly framed together and are cross connected by diagonal bars pivoted under the cage, and having slots connecting with pins in the slides. When the lever is out of operation, springs between the diagonal bars and the cage frame close the diagonals with a retractile action so as to draw the chair slides inwards from, and clear of the wall plates.

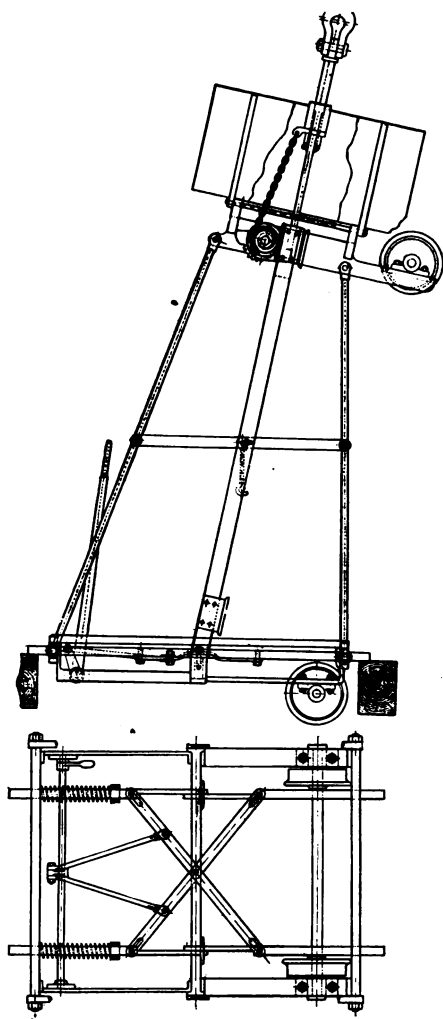
This description applying to the particular design shown does not limit the breadth of claims of the patent. In the case of vertical shafts with levels opening on opposite sides, the Gray Chairs are constructed with two levers, either of which will operate them, so that they may be handled from either side of any level. The minor features of the essential design are thus adaptable to the mine shaft upon which it is to be used, and we recommend the equipment of cages in use (as well as new shafts), with these chairs as a useful measure of economy and greater safety. Gray's Patent Chairs are used in the shafts of Hope Mine, Leiter Mine and other mining properties, and have received the endorsement of many practical mining men.

The price depends on the size of shaft and will be quoted promptly on application, giving necessary dimensions.



Gray's Patent Cage Chairs.

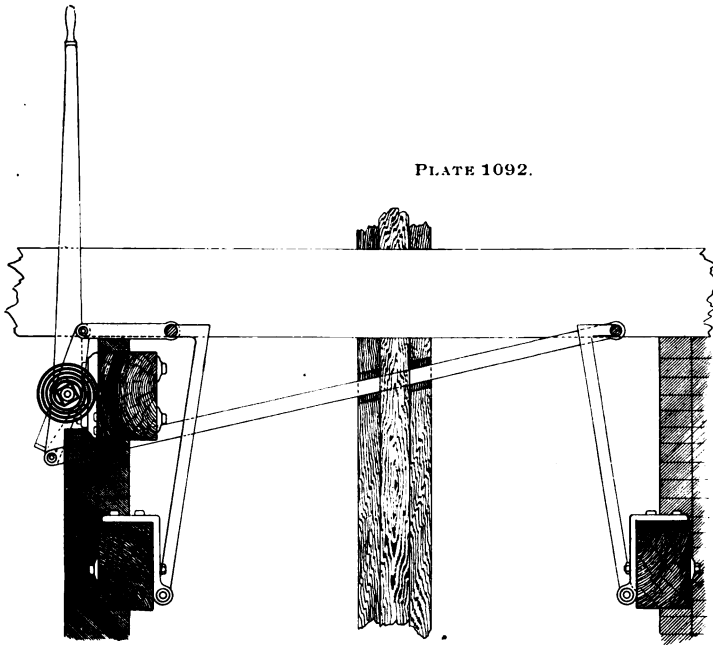
PLATE 572.



Gray's Patent Cage Chairs.—For Inclined Shafts.



## LANDING DOGS



Landing Dogs, or Chairs, unless they are built as part of the cage itself, are provided at the top of the shaft and at every level at which a cage is required to stop.

The cut above shows landing dogs of the usual form. The hand lever can be reached and operated from the cage platform if necessary.

These dogs are built to suit any size of shaft. Our design is simple, convenient and exceedingly strong.

PLATE 1086.



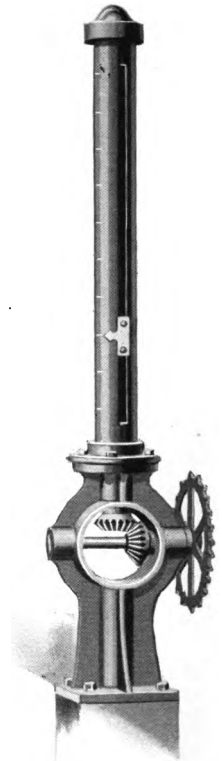
## DIAL INDICATOR

Plate 1086 shows our Dial Indicator particularly well adapted to drum hoists where the length of rope wound on drum is constant per revolution. This indicator may be driven either by a link belt from a sprocket wheel on the drum, or by gearing from the drum.

PLATE 1089.

## COLUMN INDICATOR

Plate 1089 shows our Column Indicator also well adapted to parallel drum hoists. The location of the cage is indicated by a pointer moved in accord with the movement of the cage. This indicator may also be driven by a link belt or by gearing from the drum.



## COMPENSATING DIAL INDICATOR

PLATE 1090.

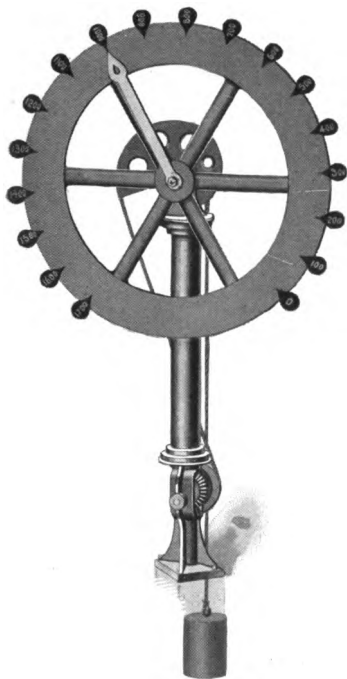
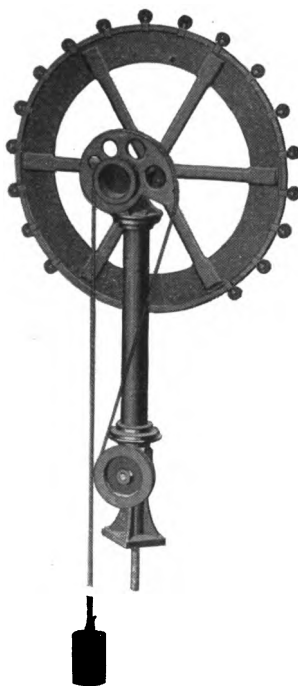


PLATE 1091.



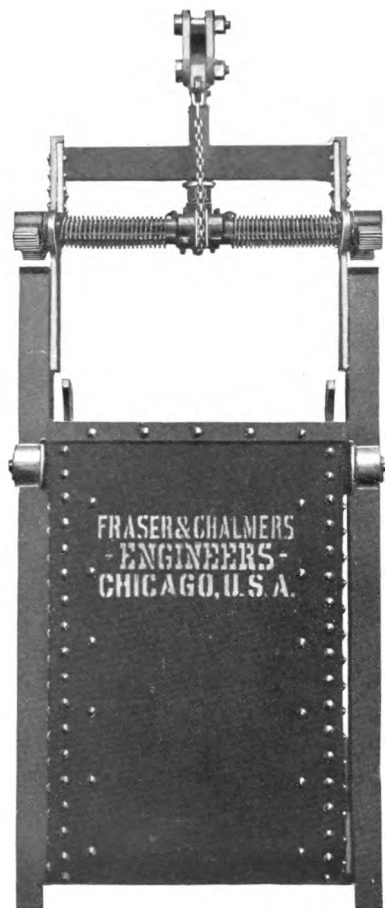
Plates 1090 and 1091 are front and back view of our Dial Indicator fitted with Compensating Device. This indicator is especially valuable when used on Reel or Conical Drum Hoists, for by means of the Compensating device the hands are moved at a speed proportionately with that of the rope. The speed varies as the rope winds or unwinds on the reel.

Prices quoted upon application.

ALLIS-CHALMERS CO., CHICAGO.

## SELF-DUMPING SKIP FOR VERTICAL SHAFT

PLATE 967.



The much greater tonnage that could be raised from an inclined shaft by the use of self-dumping skips as compared with ordinary hand loaded and unloaded cages, led us to offer the above design for vertical shafts. It combines the advantages of automatic dumping possessed by skips as used on inclined shafts, with the safety of the cages for vertical shafts.

This type of skip is being used in the Chapin Iron Mine, the De Beers Diamond Mines, the Alaska Mines and others.

ALLIS-CHALMERS CO., CHICAGO.

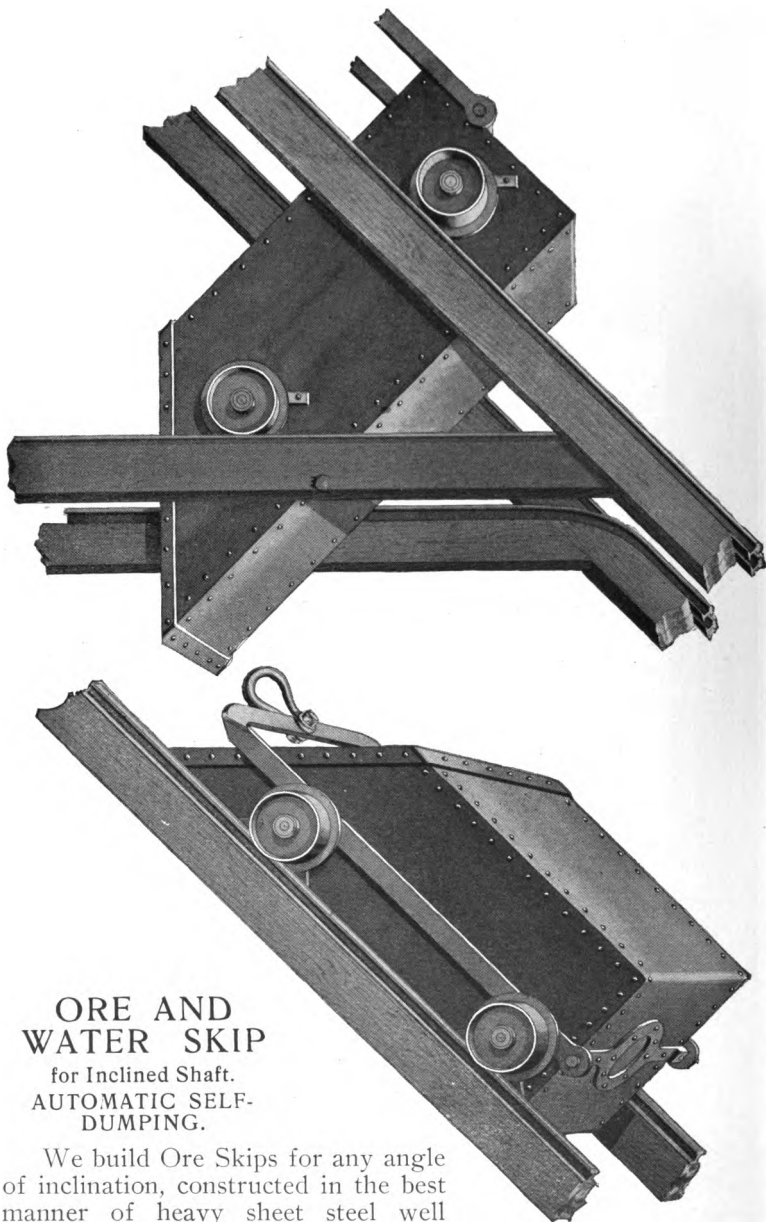
## SELF-DUMPING SKIP FOR VERTICAL SHAFT

PLATE 968.



These skips can be made of any capacity and to suit any size shaft. They may also be provided with hoods in case no other means of carrying men are provided. Or they may be suspended under a single deck cage. In the latter case the cage deck would be used for men and timbers and the skip for ore only.

In inquiring for prices give capacity of skip and size of shaft. When using these skips a special dumping arrangement is necessary in the gallows frame.



## ORE AND WATER SKIP

for Inclined Shaft.  
AUTOMATIC SELF-  
DUMPING.

We build Ore Skips for any angle of inclination, constructed in the best manner of heavy sheet steel well braced with angle iron. These are designed for automatic dump, with rear wheels of wider face than front wheels, which pass through an opening at the point arranged for dumping.

Water skips are provided with automatically opening valve.

When ordering give exact size of shaft in the clear, and angle from the horizontal. Prices on application.

## ORE BUCKETS

PLATE 17.



Fig. 1.



Fig. 2.

Figure 1 shows a tapered side, self-dumping, ore bucket with safety link. This bucket is preferred by some, but owing to projecting rim and bail, it is not as safe as bucket shown by Figure 2.

Figure 2 shows a Cornish Kibble arranged to dump by hooking to an eye on bottom of bucket. The shells of these buckets are  $\frac{1}{4}$  inch thick and bottoms  $\frac{3}{8}$  inch thick steel.

## STANDARD SIZES, FIG. 2.

Code Words.	Diameter in Inches.			Height (Inches)	Weight (Pounds)	Capacity (Cubic Ft.)
	Top	Center	Bottom			
Abimeras .....	16	18	14	26	180	2.5
Abinadab .....	18	16	16	26	180	2.5
Abinicio .....	18	20	16	26	200	3.34
Abirato .....	20	16	16	30	220	4.
Abismaba .....	21	26	21	36	350	9.
Abirren .....	21	24	18	30	280	5.5
Abishag .....	22	24	20	30	290	6.
Abismamos .....	27	30	24	30	350	10.
Abismales .....	22	26	22	36	355	9.1
Abismo .....	24	26	24	32	320	8.5
Abissando .....	24	26	22	36	348	9.
Abissare .....	28	30	28	38	470	13.8

The above sizes being frequently ordered are coded and listed for convenience, but we will build buckets of any specified size, weight and capacity with equal promptness. Prices on application.

ALLIS-CHALMERS CO., CHICAGO.

## WATER BUCKETS

PLATE 164.



These have fixed bails and bottom valves. They are made of steel plate in the best manner, and are useful where the volume of water to be raised does not warrant the expense of an independent pumping plant.

### STANDARD SIZES.

Code Words.	Diameters in Inches.			Depth (Inches)	Finished Weight (Pounds)	Capacity (Gallons)
	Top	Center	Bottom			
Abitudine.....	18	20	16	30	240	34
Abituro.....	20	22	18	32	275	43.5
Abiturum.....	24	26	21	36	340	74
Abijachen.....	24	26	22	36	370	76
Abjagen.....	26	30	24	42	470	100
Abjammern.....	27	30	25	42	476	118
Abjeccao.....	26	29	24	52	535	127
Abjectly.....	28	31	26	52	580	142
Abjectness.....	33	36	30	54	700	200

Buckets of any other Sizes or Capacities, Built and Furnished with Equal Promptness. Prices on Application.



ALLIS-CHALMERS CO., CHICAGO.

# STANDARD SIDE AND END DUMP MINING CAR

PLATE 730 B.



TABLE OF SIZES AND WEIGHTS.

Capacity (Cubic Feet.)	Car No.	DIMENSIONS OF BODY.			Weight (Pounds.)
		Length (Inches.)	Width (Inches.)	Depth (Inches.)	
8	200	36	24	16	600
10	201	36	24	20	680
12	202	42	24	21	720
14	203	42	24	24	770
16	204	48	24	24	800
18	205	48	30	22	820
20	206	48	30	24	840
22	207	54	30	22	860
24	208	54	30	26	900
26	209	54	32	26	950
28	210	60	34	24	1000
30	211	60	34	26	1050

Car sides and ends are No. 10 tank steel, bottom is of  $\frac{1}{4}$ -inch steel, door of 3-16-inch steel, unless otherwise specified.

For over-all dimensions, add 6 inches to length and 5 inches to width of body.

## **“LOAD”**

**Explanation of term as used in connection with raising  
ore from mines.**

In hoisting engine transactions it is absolutely necessary that the exact meaning of the word “load” should be understood by both parties.

In order to avoid confusion we call the amount of ore raised the “net load,” and the weight of ore, car, cage and rope the “total load.” The last item (ROPE), is very frequently overlooked in correspondence about hoisting engines. In the case of flat rope hoisting from deep mines, the weight of the rope is usually greater than the remainder of the total load. Considering this, it can be appreciated that the weight of the rope has great influence in determining the size of hoisting engine.

Where hoisting is done with the weight of certain parts of the total load counterbalancing the weight of others, hoisting is said to be “in balance.” The remaining weight is UNBALANCED LOAD, and is that which the engine must lift; but the strength of the various parts, such as clutches, shaft, etc., must be proportioned to stand the total load. Hence, it is not sufficient to state unbalanced load only.

## PROPER WORKING LOAD FOR STEEL WIRE ROPE

Certain empirical rules have been in vogue for the determination of the proper working load of wire rope. These were the results of attempted generalizations based on limited experience. Scientific study has shown that such rules are not reliable, especially with reference to minimum diameters of sheaves.

Below is given a thorough method of properly adapting steel ropes to the work required of them, especial attention being given to the importance of bending strain in determining the proper working load of the rope.

The steel used for wire rope referred to in the diagram is usually called crucible cast steel and is assumed to have an average ultimate tensile strength of 85 gross tons, or 190,000 pounds per square inch. 50,000 pounds is assumed as the proper working strain in the material, this strain being made up of the load itself, and that due to the bending of the wires over the drum. There are other grades of steel, known as "extra strong crucible cast steel" and "plow steel." Their qualities are different from the grade used in the table, and, when they are desired, should be specially calculated for. In a general way the bending strain is expressed by the formula:

$$S = \frac{E}{2} \times \frac{a}{R}, \text{ in which formula:}$$

S=strain per square inch due to bending.

E=modulus of elasticity which for crucible cast steel is approximately 29,400,000.

a=diameter of each individual wire.

R=radius of drum upon which rope is wound.

By making the proper divisions the formula is simplified to

$$S = \frac{14,700,000 \times a}{R}$$

For ropes of 19 wires to the strand the diameter of each individual wire is almost exactly 1-15 part of the diameter of the rope, and the formula given for strain in the diagram has been transformed

to suit the diameter of the rope itself as well as the *diameter* of the drum instead of the *radius* of the drum, because it was thought that the formula so expressed was much more convenient for use.

The load which wire rope can carry when wound over different drums has been figured in the following manner. If the drum is infinitely large, the load would be equal to 50,000 pounds  $\times$  the actual cross-section of steel in the rope. Suppose, now, for example, that the strain produced by bending would amount to 20,000 pounds, then the remaining strength, which would be useful in carrying the load, would be only 30,000 pounds, and by figuring in this way for different diameters of drums and ropes, the lines are found as shown on the diagram. The formula for load (L), given on the diagram, is worked out on this basis, and from this it will be seen that the loads given at the extreme right on the diagram are not at all the maximum loads the rope will carry, but are simply the loads which they will carry when used on 20 foot drums. Larger drums are, of course, seldom used, and it is an easy matter to figure out the proper working load for extreme cases.

As to the actual factor of safety it will be seen from the foregoing that it is equal to  $\frac{190000}{50000}$  or 3 8-10.

This co-efficient may appear somewhat small, because we are used to speak of factors of safety of six or larger. This is, however, only because of ignorance of the actual conditions. As a matter of fact we have been working with much lower factors of safety. It is well known that ropes often carry much higher loads than those shown on the diagram, in which case they, of course, are strained more than 50,000 pounds per square inch, when the strain due to bending is taken into consideration, which is just as actual as the strain due to the load. In fact it is more so, because there is not always a full load on the rope every time it is hoisted, but there is the full bending strain. The loads shown on the diagram agree very closely with those used in the best mining practice.

PLATE 645.

## PROPER WORKING LOAD

*For Steel Hoisting Ropes made with 19 wires to the strand, when used on drums of different diameters. Total strain of Wire Rope including bending strain and the strain due to load assumed at 50,000 lbs. per square inch of actual Steel section.*

$d$  = diameter of rope in inches.

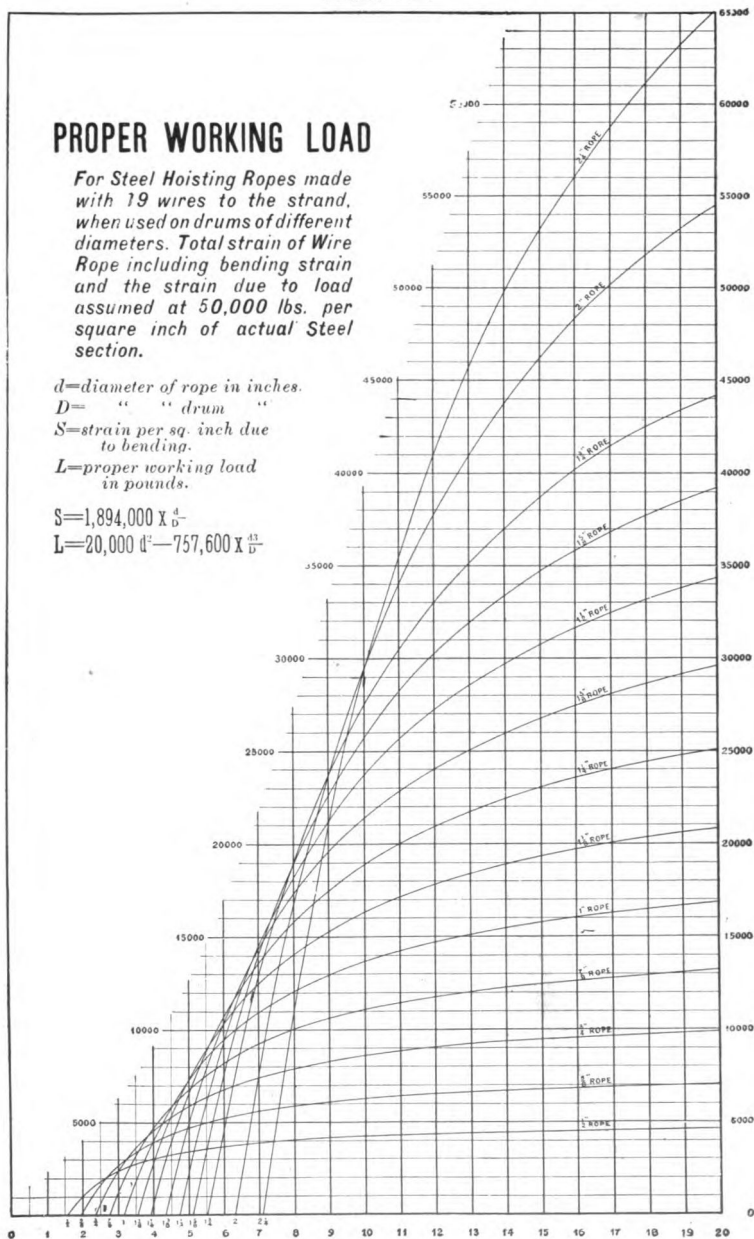
$D$  = " " drum " "

$S$  = strain per sq. inch due to bending.

$L$  = proper working load in pounds.

$$S = 1,894,000 \times \frac{d}{D^2}$$

$$L = 20,000 d^2 - 757,600 \times \frac{d}{D}$$



## STANDARD WIRE HOISTING ROPE

This rope is usually made with a hemp center, which adds to the pliability and diminishes internal friction in bending. With wire center the weight is about ten per cent more than with hemp.

The choice of rope depends upon three main points: (1) load; (2) smallest diameter over which used; (3) liability to external wear. As the question involves so many points when the material, number of wires and diameter of rope are to be decided upon, a general statement cannot be made to cover all the principles. Those ropes made of softer materials are more pliable, but have less total strength and wear more quickly. Those of harder materials are stiff, but suffer less from surface abrasion.

The rope generally used for hoisting is called crucible cast steel rope, except for great depths, in which cases plough steel rope is used.

The materials as arranged in the table of sizes, page 113, are in the order of hardness. Their stiffness and ultimate tensile strength are in the same order.

## STANDARD HOISTING ROPE

Made of Swedish Iron, Crucible Cast Steel, or Plough Steel, having six strands of nineteen wires each, with hemp center.

Trade Number.	Approximate Circumference in Inches.	Diameter in inches.	Weight Per Foot in Pounds.
00	8 $\frac{5}{8}$	2 $\frac{3}{4}$	12.00
0	7 $\frac{7}{8}$	2 $\frac{1}{2}$	10.00
1	7 $\frac{1}{8}$	2 $\frac{1}{4}$	8.00
2	6 $\frac{1}{4}$	2	6.30
3	5 $\frac{1}{2}$	1 $\frac{3}{4}$	5.25
4	5	1 $\frac{5}{8}$	4.10
5	4 $\frac{3}{4}$	1 $\frac{1}{2}$	3.65
5 $\frac{1}{2}$	4 $\frac{1}{4}$	1 $\frac{3}{8}$	3.00
6	4	1 $\frac{1}{4}$	2.45
7	3 $\frac{1}{2}$	1 $\frac{1}{8}$	2.00
8	3	1	1.58
9	2 $\frac{3}{4}$	$\frac{7}{8}$	1.20
10	2 $\frac{1}{4}$	$\frac{3}{4}$	0.88
10 $\frac{1}{4}$	2	$\frac{5}{8}$	0.60
10 $\frac{1}{2}$	1 $\frac{3}{4}$	$\frac{9}{16}$	0.48
10 $\frac{3}{4}$	1 $\frac{1}{2}$	$\frac{1}{2}$	0.39
10a	1 $\frac{1}{4}$	$\frac{7}{16}$	0.29
10b	1 $\frac{1}{8}$	$\frac{3}{8}$	0.23
10c	1	$\frac{5}{16}$	0.15
10d	$\frac{3}{4}$	$\frac{1}{4}$	0.10

Diagram showing net strength of round rope is given on page III.

## FLAT WIRE ROPE

Flat wire rope is composed of several round ropes, whose diameter is equal to the thickness of the flat rope required laid side by side and sewed together with iron or annealed cast steel wire. The ropes composing it are alternately of right and left hand twist, and have four strands, being without hemp or wire center. This peculiarity in manufacture is rendered necessary in order to permit the insertion of the sewing wire and to make the rope more compact. The number of wires composing each strand is generally seven, or, if especially ordered, nineteen or a combination of large and small wires.

In determining the proper size of flat rope to do certain work, the formula herein given for round rope must be used to ascertain strains due to bending the wires. In applying this formula, it must be remembered that in flat rope the actual diameter of the wires is greater than that of the wires in round hoisting rope of the same diameter, this being due to the flat rope being made with fewer wires to the strand. The reel center is the smallest diameter over which the rope is bent and this should be the radius used in the formula.

While makers of rope usually state that flat rope has the same breaking strain as round rope of same weight and material, this is strictly true only when diameter of wires composing both ropes are the same.



## TABLE OF STANDARD SIZES OF FLAT WIRE ROPE

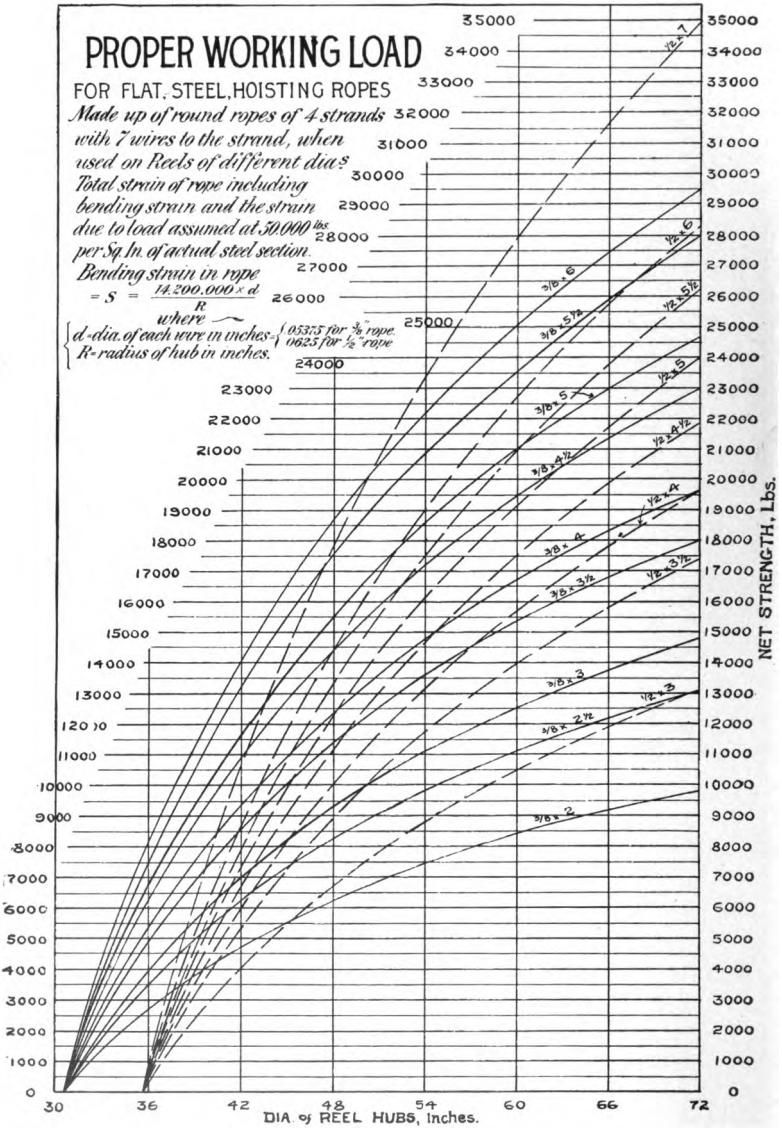
Width	Thickness	Weight, s. Per Foot.	Width	Thickness	Weight, bs. Per Foot.
7	$\frac{1}{2}$	5.82	6	$\frac{3}{8}$	3.90
6	$\frac{1}{2}$	4.92	$5\frac{1}{2}$	$\frac{3}{8}$	3.57
$5\frac{1}{2}$	$\frac{1}{2}$	4.47	5	$\frac{3}{8}$	3.25
5	$\frac{1}{2}$	4.02	$4\frac{1}{2}$	$\frac{3}{8}$	2.92
4	$\frac{1}{2}$	3.67	4	$\frac{3}{8}$	2.60
$3\frac{1}{2}$	$\frac{1}{2}$	3.22	$3\frac{1}{2}$	$\frac{3}{8}$	2.30
3	$\frac{1}{2}$	2.32	3	$\frac{3}{8}$	2.00
.....	.....	.....	$2\frac{1}{2}$	$\frac{3}{8}$	1.69
.....	.....	.....	2	$\frac{3}{8}$	1.37

The wire in  $\frac{1}{2}$  in. rope is approximately .0625 in diameter, and " $\frac{3}{8}$ " rope .05375.

The chief drawbacks to the use of flat rope are first cost and the rapid wear of the sewing wires.

Diagram giving net strength of flat ropes over reels of different diameters is shown on page 116.

PLATE 1258.





## SPECIAL HEAVY SHEAVES

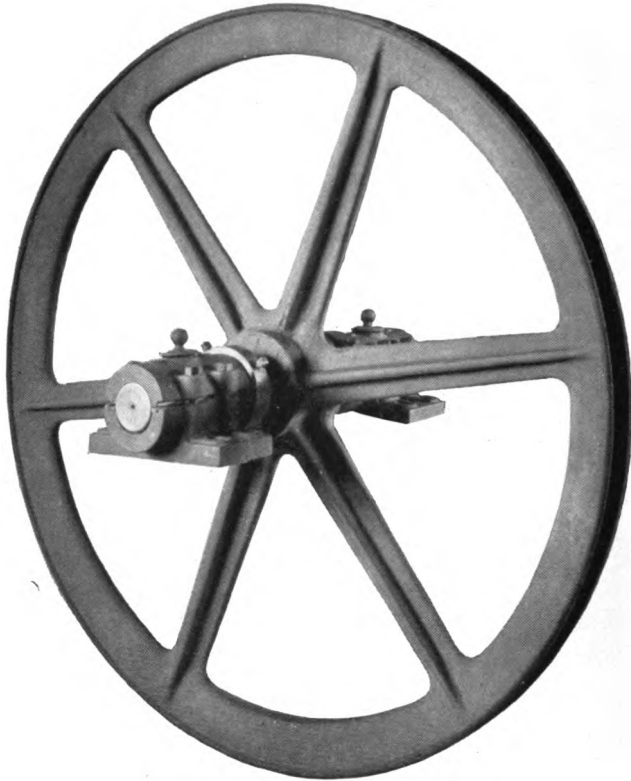
The above cut illustrates our design of large sheaves for heavy duty, which are generally made with wrought iron spokes cast in. These large sheaves are made in halves with the rim joints bolted together, and the hubs either bolted or held together by means of a wrought iron ring shrunk on.

We are prepared to build sheaves of any size, and will make quotations on receipt of necessary information.

ALLIS-CHALMERS CO., CHICAGO.

# SHEAVE WHEEL, WITH SHAFT AND BOXES

PLATE 1088.



## SHEAVES FOR ROUND ROPE.

Diameter.	Size Rope.	Weight, Sheave only.	Weight, with Shaft and Boxes.
18 in.	$\frac{3}{8}$ to $\frac{1}{2}$ in.	86 lbs.	120 lbs.
24 "	$\frac{1}{2}$ " $\frac{5}{8}$ "	115 "	190 "
30 "	" $\frac{5}{8}$ "	165 "	315 "
36 "	" $\frac{3}{4}$ "	250 "	430 "
42 "	" $\frac{3}{4}$ "	440 "	665 "
48 "	$\frac{3}{4}$ to $\frac{7}{8}$ "	460 "	750 "
60 "	$\frac{7}{8}$ " 1 "	900 "	1200 "
66 "	" 1 "	1100 "	1400 "
72 "	1 to $1\frac{1}{8}$ "	1200 "	1800 "
84 "	" $1\frac{1}{8}$ "	1530 "	2400 "
96 "	$1\frac{1}{8}$ to $1\frac{1}{4}$ "	1950 "	3030 "

## SHEAVE WHEELS

Plate 1088 on opposite page represents our Standard Sheave Wheel with shaft and boxes complete, designed for mining and all other purposes where it is desired to lead wire rope over a sheave with the minimum of friction and wear. The sheave itself is a substantial casting with deep flanges turned out true and smooth to receive the rope.

The shaft is of the best grade of mild steel, and of ample strength for all ordinary hoisting purposes. The boxes are lined with the best quality of anti-friction metal, and have adjustable caps for taking up the wear. The caps are provided with oil or tallow cups.

The sheaves are fastened to the shaft either by a key or set screw. Special designs of sheaves, with wood, hemp or rubber lined grooves, are made to order and provided with various styles of boxes or pedestals. To meet exceptionally heavy conditions, we build sheaves with wrought iron arms, as shown on page 117. Our standard sheaves are of ample strength to carry the load for which the size of rope given in the table is suitable.

### SHEAVES FOR FLAT ROPE.

Diameter.	Size Rope.	Weight, Sheave only	Weight, with Shaft and Boxes.
36 in.	3 × $\frac{3}{8}$ in.	450 lbs.	600 lbs.
48 "	3½ × $\frac{3}{8}$ "	750 "	1,000 "
60 "	4 × $\frac{3}{8}$ "	1,300 "	1,800 "
72 "	4½ × $\frac{3}{8}$ "	1,925 "	2,800 "
84 "	5 × $\frac{3}{8}$ or ½	2,200 "	3,260 "
96 "	5½ × ½ in.	2,400 "	3,400 "

## HOISTING HOOKS

Hoisting Hooks of different styles are shown in plate 178. The safety hook (Figures 1, 2 and 3) is designed to prevent accident due to overwinding of hoisting rope, which may occur from carelessness of the engineer or derangement of engine. Without the safety hook the cage may be drawn up to the head sheave, causing the rope and possibly the sheave to break.

Figure 1 shows the safety hook closed at top, as it would enter the stationary safety stop when accidentally overwinding. Figure 2 represents edge view of safety hook. Figure 3 illustrates the action of the safety hook. Having, by overwinding of hoisting rope, come in contact with safety stop, the spreading plates close at bottom, causing their upper portions to open like scissors, releasing the rope clevis; the rope clevis instantly freed, passes on with the rope, at the same moment the plates spreading at the top, drop and rest on the safety stop, thus suspending the cage until the runaway rope is again attached.

After overwinding has occurred and the rope has been brought back with lifting clevis close to hook plates, insert the long clevis (sent with each hook) through the lifting clevis, first taking out the pin of long clevis. Insert this pin into the crossed diagonal slots in swinging plates, passing pin through the long clevis; then put a slight strain on the hoisting rope, when the swinging plates will immediately fall into place and the cage can be lowered on to the landing dogs, where the long clevis is taken out and lifting clevis returned to its original place. A new copper rivet is now inserted below central pivot bolt and riveted up, when the hook is again ready for duty. The copper rivet is of strength sufficient to hold plate when hoisting ordinarily, but capable of being broken when overwinding. There are many forms of safety hooks for heavy loads, but this form excels them all.

Figure 4. Snap Hook. This hook is of simplest form, with a steel snap spring which effectually prevents bucket bail from escaping.

Figure 5. Serpentine Hook. This hook is sometimes used when frequent removing of bucket is required, necessitating a ring or two on bucket bail for convenience. It gives comparative safety by its form.

Figure 6. Chain Hook. A simple construction for use with buckets for small hoists; this hook and chain serves every purpose of strength and safety as well as convenience, and we recommend it for light loads.

# HOISTING HOOKS

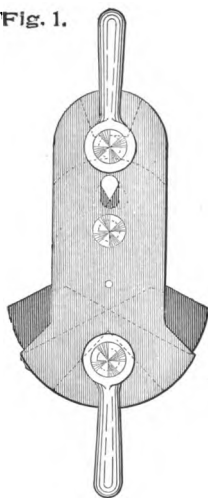
PLATE 178.

## CODE WORDS:

Fig. 1-3. For—round rope: **Aigrette.**  
 Fig. 1-3. For—flat rope: **Aigreur.**  
 Fig. 1-3. For—tons: **Aigrissons.**

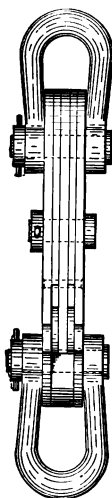
Fig. 4. **Aiguade.**  
 Fig. 5. **Aiguire.**  
 Fig. 6. **Aiguille.**

Fig. 1.

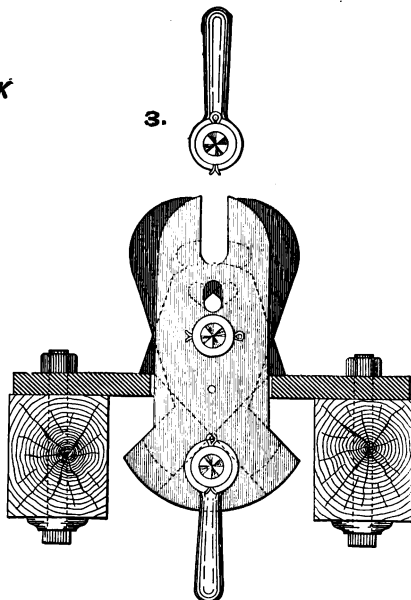


**SAFETY HOOK**

2.

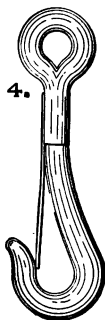


3.



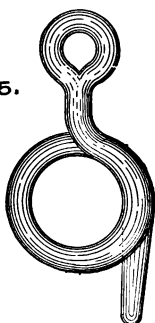
**SNAP HOOK**

Fig. 4.



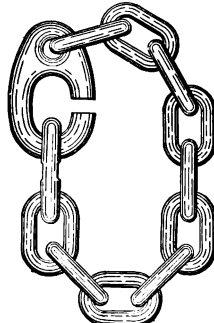
**SERPENTINE HOOK**

5.



**CHAIN HOOK**

6.



# TABLE FOR COMPUTING EFFECTIVE WEIGHT OF A LOAD

I. Degree.	II. Sine.	III. Cosecant.	I. Degree.	II. Sine.	III. Cosecant.
90	1.000	1.000	45	.707	1.414
89	1.000	1.000	44	.695	1.440
88	.999	1.001	43	.682	1.466
87	.999	1.001	42	.669	1.494
86	.998	1.002	41	.656	1.524
85	.996	1.004	40	.643	1.556
84	.995	1.006	39	.629	1.589
83	.993	1.008	38	.616	1.624
82	.990	1.010	37	.602	1.662
81	.988	1.012	36	.588	1.701
80	.985	1.015	35	.574	1.743
79	.982	1.019	34	.559	1.788
78	.978	1.022	33	.545	1.836
77	.974	1.026	32	.530	1.887
76	.970	1.031	31	.515	1.942
75	.966	1.035	30	.500	2.000
74	.961	1.040	29	.485	2.063
73	.956	1.046	28	.469	2.130
72	.951	1.051	27	.454	2.203
71	.946	1.058	26	.438	2.281
70	.940	1.064	25	.423	2.366
69	.934	1.071	24	.407	2.459
68	.927	1.079	23	.391	2.559
67	.921	1.086	22	.375	2.669
66	.914	1.095	21	.358	2.790
65	.906	1.103	20	.342	2.924
64	.899	1.113	19	.326	3.071
63	.891	1.122	18	.309	3.236
62	.883	1.133	17	.292	3.420
61	.875	1.143	16	.276	3.628
60	.866	1.155	15	.259	3.864
59	.857	1.167	14	.242	4.134
58	.848	1.179	13	.225	4.445
57	.839	1.192	12	.208	4.810
56	.829	1.206	11	.191	5.241
55	.819	1.221	10	.174	5.759
54	.809	1.236	9	.156	6.392
53	.799	1.252	8	.139	7.185
52	.788	1.269	7	.122	8.206
51	.777	1.287	6	.105	9.567
50	.766	1.305	5	.087	11.474
49	.755	1.325	4	.070	14.336
48	.743	1.346	3	.052	19.107
47	.731	1.367	2	.035	28.654
46	.719	1.390	1	.017	57.299

Column II is the trigonometric sine of angle given in Column I.  
Column III is the trigonometric cosecant of angle given in Column I.



## EXPLANATION OF TABLE GIVEN ON THE PRECEDING PAGE

The table on the preceding page will be found useful where hoisting is done on inclined shafts. It may also be applied to "gravity tramways" or "inclined planes."

The following examples will show its uses:

Suppose the weight of ore is 10,000 lbs.; skip, 6,000 lbs.; rope, 7,500 lbs., and that the shaft has an inclination of 55 degrees from the horizontal. What is the strain of the rope? Total load,  $10,000 + 6,000 + 7,500 = 23,500$ .

RULE: For each pound weight, the effective load on rope for the angle of incline from the horizontal given in column I will be found opposite in column II. Therefore, find 55 degrees in column I and opposite in column II is .819, which, multiplied by  $23,500 = 19,246.5$  lbs., the total *effective strain on rope*.

Suppose an engine can raise 5,000 lbs. in a vertical shaft, what can it pull up an incline 30 degrees from the horizontal?

RULE: For each pound which an engine can lift vertically, it can raise the amount given in column III up an incline of the angle given in column I. Therefore, find 30 degrees in column I, and opposite in column III is 2, which multiplied by 5,000 = 10,000 lbs., the amount engine can pull up a 30 degree incline.

If the proper working strain of the rope were 5,000 lbs. on a vertical lift, it would be 10,000 lbs. on a 30 degree incline; the process is the same.

Note:—In using the table, it must not be overlooked that the friction of drawing the car, skip or cage on the rails or guides is to be added to the effective weight in order to obtain the total amount of strain borne by the rope. This friction is termed "traction" or "tractile effort" and varies between thirty and one hundred pounds per ton, according to circumstances, and is of more importance on inclines of small angle.

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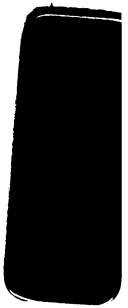
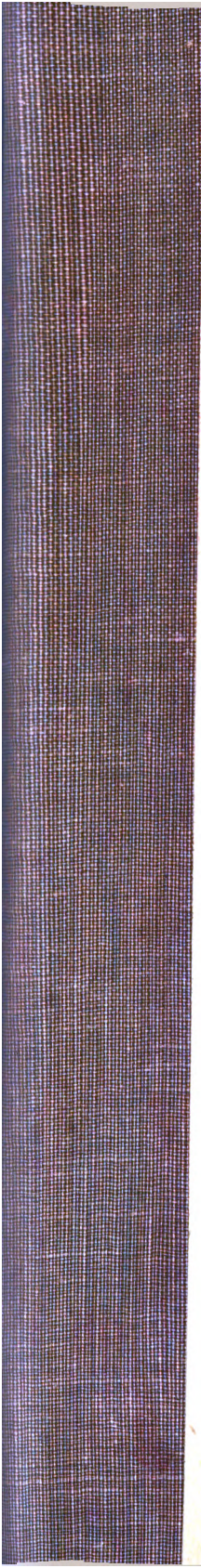
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